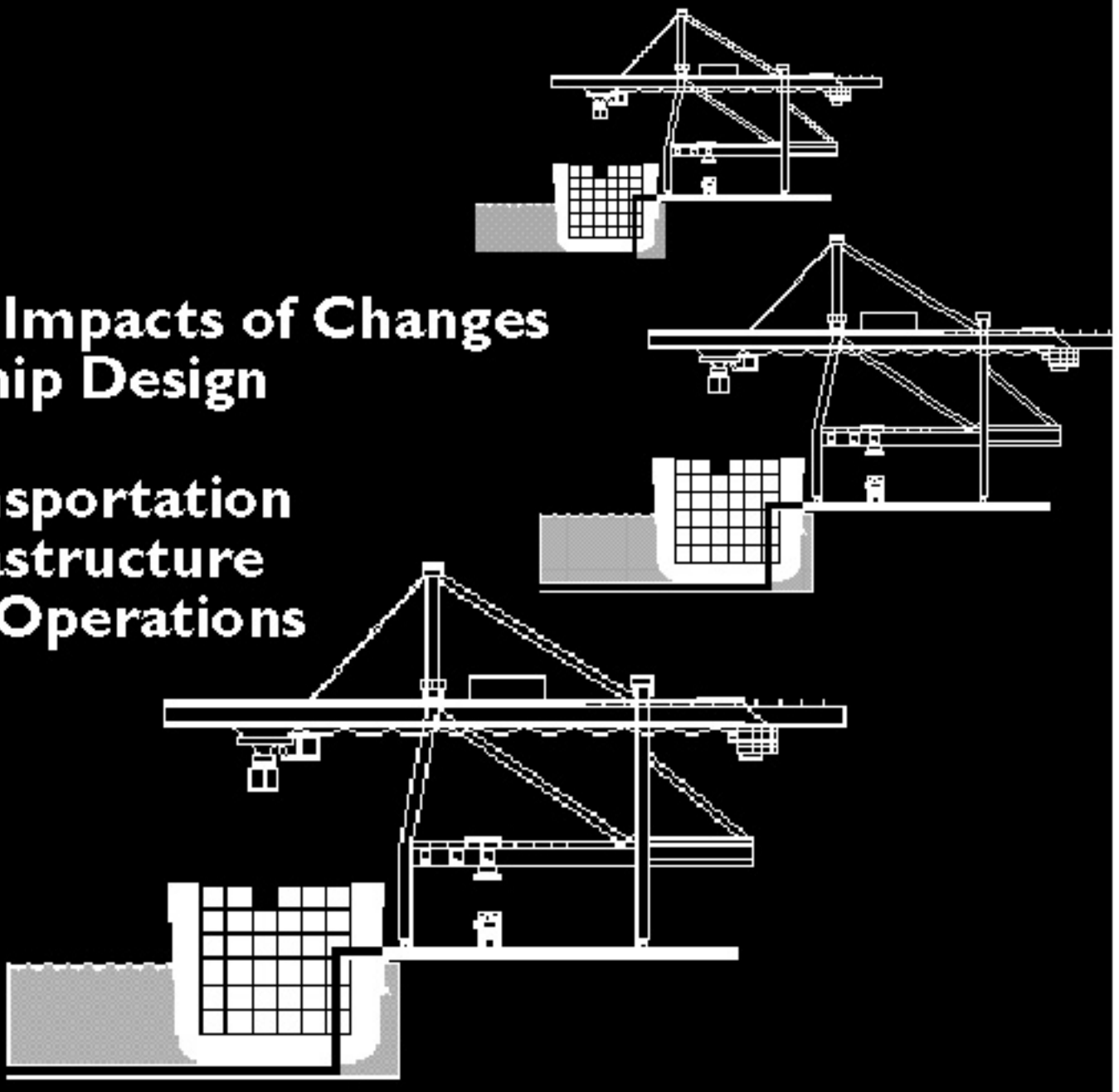
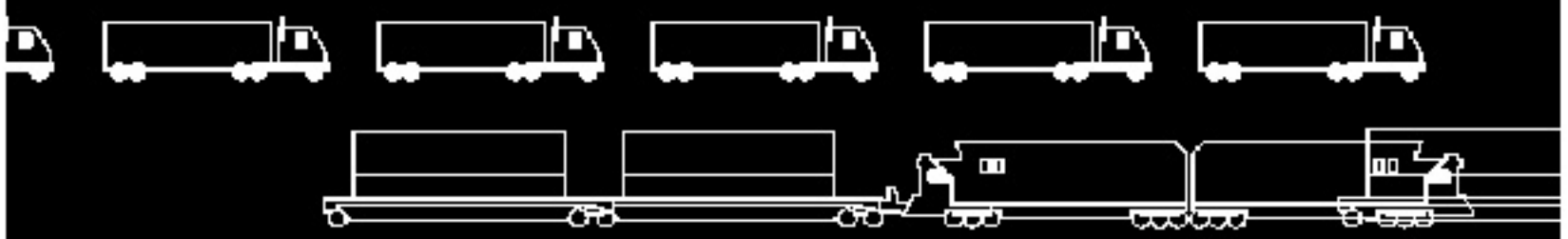
U.S. Department
of Transportation

Office of Intermodalism

February 1998

The Impacts of Changes in Ship Design on Transportation Infrastructure and Operations





Executive Summary

This report presents the input received by the U.S. Department of Transportation (USDOT) at four regional meetings addressing the question of how the growth in worldwide containerized trade and the expected growth in volumes of freight handled by major container ports will place additional demands on the U.S. transportation system. The meetings paid particular attention to the introduction of large containerships (megaships) and their potential impact on freight transportation within the United States. The series of regional megaship meetings were successful in getting participants from Federal, State, and local agencies and the private sector to think about solving the full spectrum of transportation problems created by larger ships calling on U.S. ports.

The megaship study was carried out through a cooperative effort that involved the following USDOT Offices and Agencies: the Secretary's Office of Intermodalism, the Federal Highway Administration, the Maritime Administration, the Federal Railroad Administration, and the U.S. Coast Guard. Other Federal agencies with significant participation at the regional meetings included the Department of Defense (including the Army Corps of Engineers), the U.S. Customs Service, and the Environmental Protection Agency.

The fundamental issue addressed in these conferences was how improving infrastructure links to ports is a critical prerequisite for transportation to function as a system. In the regional meetings, the major factors and requirements for infrastructure planning and investment occasioned by changes in ship design were:

- Megaships are being constructed with carrying capacities exceeding 4,500 TEUs (twenty-foot equivalent units) and/or fully-loaded design drafts of 40 to 46 feet, and some major U.S. ports are currently unable to handle them.
- International ports are expanding capacity to meet the challenge of megaships and the projected growth in trade.
- How transportation inefficiencies can be reduced was at the crux of the megaship meetings, as was the dilemma posed by conflicting demands for increased investment in a fiscally-constrained environment.
- On the question of whether carriers would be likely to share in the cost of infrastructure investments occasioned by their vessels, port officials noted that carriers have not paid their full share of port infrastructure improvements to date, nor do ship owners typically consult with ports on long range planning for port infrastructure.
- The U.S. Treasury receives $150 billion annually in tax revenues from goods handled by U.S. ports, and continued investment in our ports is essential to ensure that they remain competitive in the global economy and act as a vital component of our national security infrastructure.
- Port and local representatives believed that more of the fees and duties collected at the ports ought to be returned to the ports that collect them.
- In addition to providing money for large scale capital improvements, the Federal Government could create incentives to reward public and quasi-public entities for becoming more transportation efficient.

- The challenge to transportation decisionmakers is to consider differences between the commercial life and operational life of an investment—what is the likely long-term impact of investments made to increase transportation capacity to accommodate potential port calls by larger and/or faster ships?
- Industry representatives called for the U.S. DOT to provide a more logical user-based fee to eliminate the disparity between donors and donees and greater flexibility to finance other improvements necessitated by growth.
- Attendees felt that there are two differing planning processes that have to be resolved—State planners typically have a 5- to 10-year planning horizon, while the operating horizon of a carrier is typically of shorter range. Longer range planning is usually not shared with port service providers.
- The feedback from the regional meetings clearly called for Federal agencies to provide a planning framework for economic analysis that could assess implications of larger scale, corridor-based transportation improvements.
- Port and other transportation industry participants recognized the dilemma in not wanting port rationalization or national transportation planning, but wanting the Federal Government to set priorities for major transportation investments.
- Concerted action would have to be taken on both analytical and political processes if sound, quantitatively-based frameworks for project investment are to be approved.

There are three major national public policy issues raised by the prospects of extremely large containerships: the historic and ongoing deregulation of the transportation industry, the devolution of transportation programs, and the need for optimizing our nation's freight movement system. Deregulation has allowed the formation of partnerships within and between transport modes to achieve optimization of end-to-end distribution logistics and transport costs. Devolution has enabled the empowerment of States and metropolitan planning organizations to play a larger role in transportation decisionmaking. Private shippers and public agencies are seeking to optimize the transportation system to move the most goods and people with the widest range of modal choices at the most economical cost and the greatest efficiency.

In considering the appropriate response to the new transportation technology, we can turn to historical examples where optimization of the nation's freight transportation network—by the Federal Government, by States and communities, and by transportation companies—has been vitally needed and successfully accomplished. For its part, USDOT is actively engaged in:

a) Defining the national interest with respect to freight movement through proposals for reauthorizing surface transportation programs, the National Highway System intermodal connections, the Water Resources Development Act and other initiatives.

b) Providing equitable and appropriate funding for water and landside access and infrastructure improvements, and other projects which benefit both local transportation and a defined national interest, such as the Alameda Corridor.

c) Facilitating improved coordination in the decision chain among and between vessel designers, ports/waterways management, state and municipal landside access planners (including multi-state freight transport planning), and private shipping companies.

Conclusions

The report concludes that action should be taken now to craft policies to position the U.S. transportation industry to handle the significant increases in international freight movements and the infrastructure demands of the changing trade flows and port calls by larger and faster vessels. If policies and programs are to be developed to address these transportation needs, action must be taken to engage both the agencies responsible for their oversight and the constituents that are affected.

The report acknowledges two ongoing activities within USDOT that will address the transportation system's accommodation of increased future volumes of international intermodal freight:

1) USDOT's Waterways Management Initiative: This initiative, led by the U.S. Coast Guard and the Maritime Administration, will bring together the many agencies with responsibility for waterways management to coordinate and consolidate the delivery of all Federal services and promote port efficiency. Waterways Transportation Management will focus on policy coordination at the national level and action at the local port level. Adequate infrastructure, including channel and berth depths, navigation information, port facilities, intermodal connections and information management to accommodate all classes of marine vessels—including large container vessels—are among the waterways issues encompassed within this initiative.

2) USDOT's Assessment of the Conditions and Performance of National Highway System (NHS) Intermodal Connectors: This Federal Highway

Administration initiative will compile information on the NHS connections to major passenger and freight intermodal terminals, including 500 freight terminals. Using input from other USDOT operating administrations and public/private databases at national, State, and local levels, the FHWA will:

a) Evaluate highway infrastructure condition of National Highway System (NHS) connections to major intermodal terminals.

b) Identify improvements that have been made or are being planned for intermodal connections and identify impediments to making improvements to them.

c) Identify other non-highway infrastructure, regulatory, institutional and operational impediments to intermodal terminal access.

The Department of Transportation believes that the challenges of increased movements of international freight can be met only through the coordinated efforts of the wide range of transportation stakeholders with interests in this area. These efforts will require significant investments of time, energy, and funds and continuous dialogue with our constituents if we are to be successful in meeting the transportation needs of the future.

Table of Contents

List of Tables/ Illustrations

Introduction

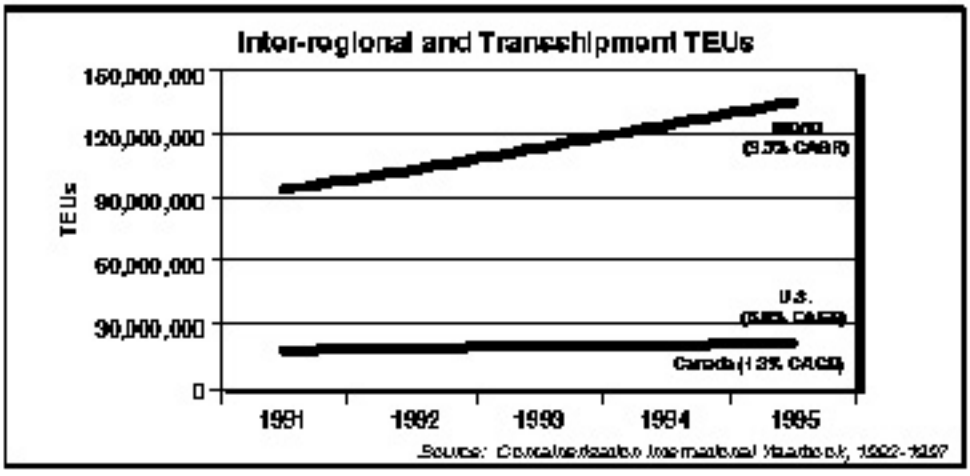
In the spring and summer of 1997, the U.S. Department of Transportation (USDOT) conducted a series of four regional meetings around the country to address transportation impacts of changes in ship design and shipping practices occurring in the intermodal shipping industry. These meetings examined existing transportation infrastructure, market trends, and how transportation planning should consider freight distribution systems that must serve both domestic and global needs. The fundamental issue addressed in these conferences was how improving infrastructure links to ports is a critical prerequisite for transportation to function as a system.

There are new dynamics in intermodal shipping caused by the elimination of international trade barriers, lower tariffs, and shifting centroids of global manufacturing and consumption. Many new trade gateways are developing which dramatically alter market demand and future cargo forecasts. Trade worldwide is growing, with 55 percent of all general cargo in international liner trade being moved in containers. Worldwide containerized trade is growing at annual rates of 9.5 percent, with 6.0 percent at United States ports and 1.5 percent at Canadian ports. By 2010, experts predict that 90 percent of all liner freight will be shipped in containers. The trend for growth is inexorably up, and every major container port is projected to double and triple its cargo traffic by 2020.

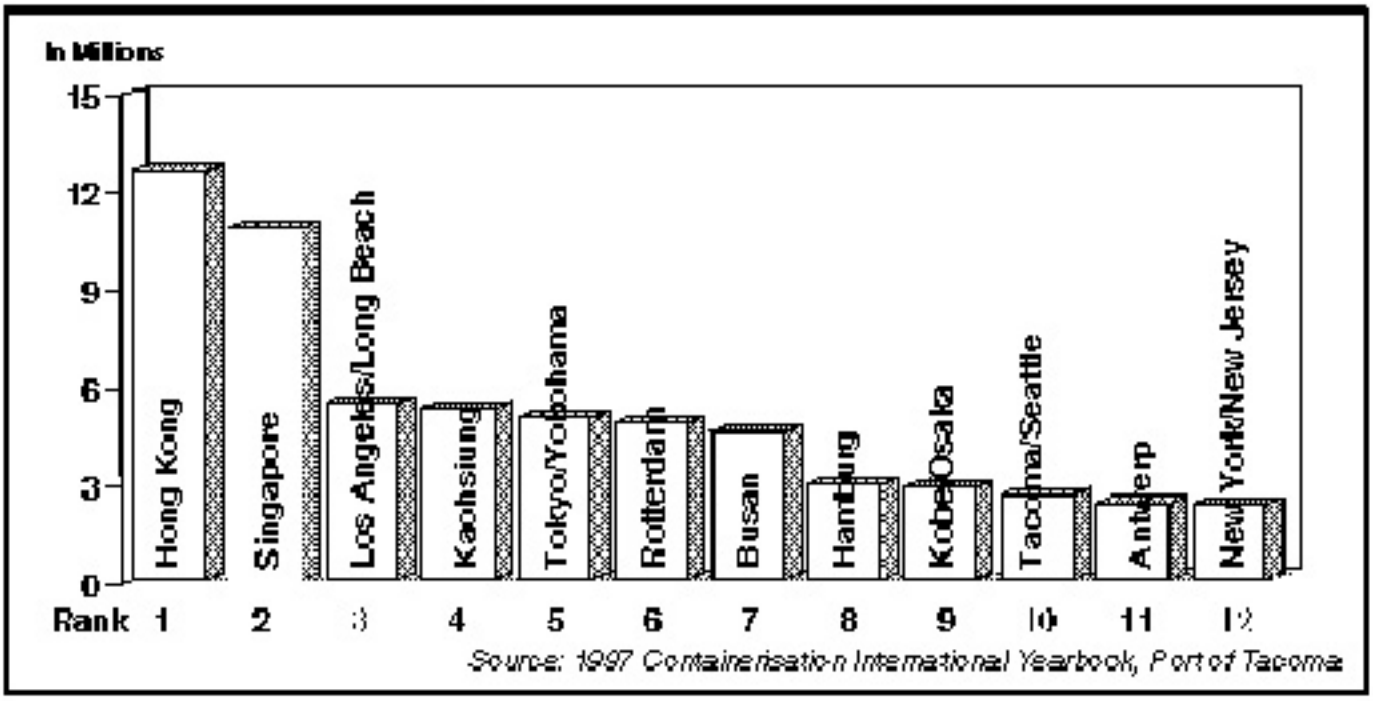
Compared to the impacts forecast for containerized freight, growth in overall volumes non-containerized commodities is expected to be substantially less (in the 1 to 3% range) and changes in ship design for these commodities will be much less significant in terms of transportation logistics and landside impacts.

Containerized growth in Asia is growing by as much as 25 percent annually. Hong Kong has developed a plan to handle 32 million containers per year by 2010, far exceeding the projected volumes for the very largest U.S. ports. There are no differences in the technology used at the major international ports that

World Container Port Traffic, (1991–1995)



1997 Top World Container Gateways (TEUs)

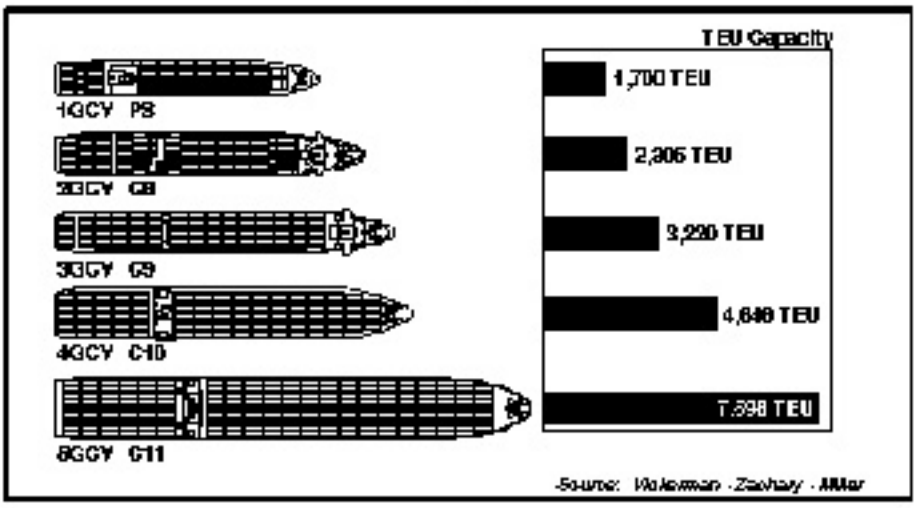


enable these ports to handle such large volumes of freight—the efficiencies are made possible by different labor agreements, operating procedures, administrative policies, and the nature of the trade in foreign countries. Our Nation's ports and their modal connections must make improvements in these areas as well, and not just in the construction of additional capacity or the reliance upon new technology, if they are to remain globally competitive and efficient components of the U.S. transportation system.

Assuming that adequate port infrastructure is available, by 2010 nearly 33 percent of general cargo tonnage will be transported by ships carrying more than 4,000 twenty-foot equivalent (TEU) container units. Megaships are being constructed with carrying capacities exceeding 4,500 TEUs and/or fully-loaded design drafts of 40 to 46 feet, and some major U.S. ports are currently unable to handle them. International ports are expanding capacity to meet the challenge of the coming megaships and the projected growth in trade. As the new containerships come into service, new routes and transshipment hubs will develop. American ports face new challenges to increase their infrastructure capacity but also new opportunities to develop markets for their services.

As a general rule, containerships will continue to get larger if costs per transit mile continue to go down. Eight percent of new ship orders are for megaships, none of which are being built in U.S. shipyards nor scheduled to fly the U.S. flag, but these ships could ultimately carry 20 percent of total containerized cargo. Ships in the 6,000 to 9,000 TEU range will grow to be about 9.5 percent of the total fleet by 2010. Megaships are more costly to build than their predecessors—$70 million for post-Panamax class vessels up to 4,800 TEUs vs. an estimated $100 million for megaships, with unit costs varying depending on the design characteristics and number of vessels

Container Ship Evolution



ordered. Megaships offer operational benefits through lower per transit costs, reduced transit time, and fewer numbers of required vessels. Because megaships are extremely capital expensive, carriers will deploy them in concentrated trade lanes and operate them over longer routes and call on fewer ports. These vessels offer economies of scale at sea, but could incur diseconomies of scale in port. Thus carriers seek to integrate landside with water economies.

Megaships, while costly in aggregate, have lower construction and operating costs per TEU of containerized freight. High-speed hull designs cut transit times, and faster transit and port turn-around times reduce the number of vessels required to maintain weekly departure schedules. Carriers will invest in megaships to increase their market share and get additional business from shippers through reduced container slot costs. The newer, larger ships cannot easily be re-deployed logistically because of port and vessel capacity constraints, and carriers will seek consistent cargo volume to stabilize rates. Every operating advantage must be squeezed out of ships to recover the greater costs of building and operating these vessels.

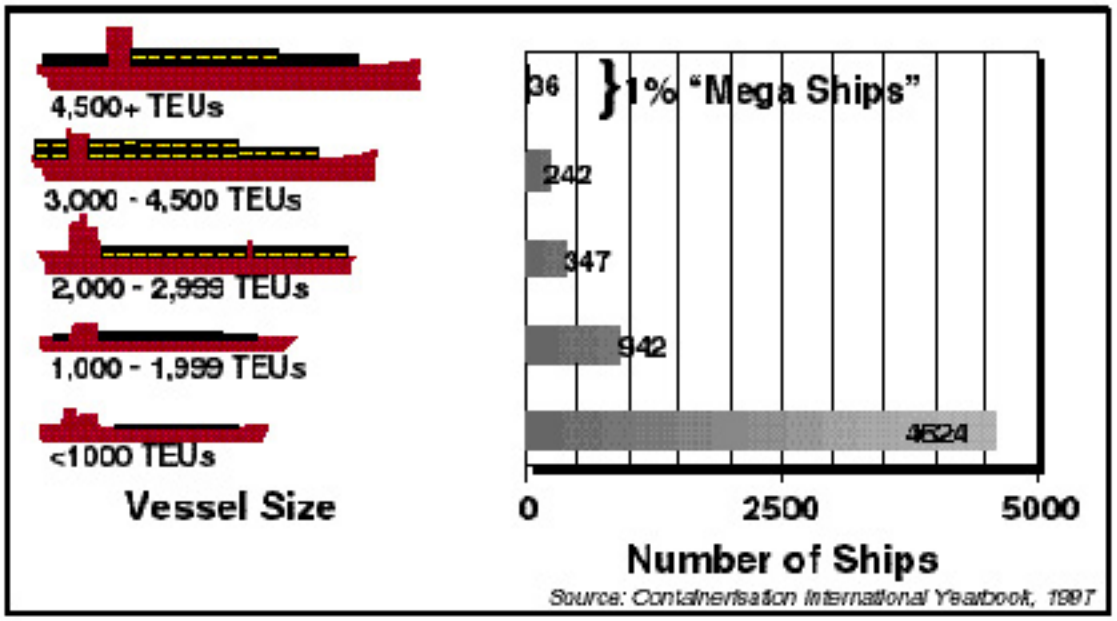
For a port to service these megaships the entire portside infrastructure will have to get bigger and more productive. Each channel, berth, and turning basin must be at least 50 feet in depth, since 40 to 46 feet will be the maximum draft for fully- loaded megaships. Megaship ports will be required to have cranes to reach across the 21 container-wide megaships as well as feeder ship to megaship transfers. Stronger wharves are also likely to be required by the ports where megaships call. Wharf strengthening may be needed to: 1) support more and heavier cranes; and/ or 2) accommodate deeper drafts at berths (in some cases deepening to accommodate megaships could undermine existing pilings); and/ or 3) support more yard equipment (trucks, yard hostlers, etc.); and/ or 4) support rail cars on the wharf.

Ports are projected to experience dramatic growth in containerized cargo, but not every port will have to increase capacity to accommodate megaships. Regardless of whether megaships call on a given port, the introduction of these vessels will have a ripple effect throughout the transportation system, not just regionally, but nationally.

If megaships call on U.S. ports, then the ports and the supporting transportation system must be able to respond. To recover their investment in a megaship, operators must minimize the time a ship is in port to maximize the number of trips it makes. The reduced time in port, plus the higher number of containers carried by a megaship, increase the peak container traffic that must be moved through the port and the surface transportation system that serves it. Except in limited markets served by inland waterways, shippers have three choices for the inland movement of containerized freight from port terminals—highways, rail, or barges/ feeder ships. The modal split that reflects how this traffic is to be moved has a profound effect on the design of terminals, both within the port and for truck, rail, and feedership/barge terminals as well.

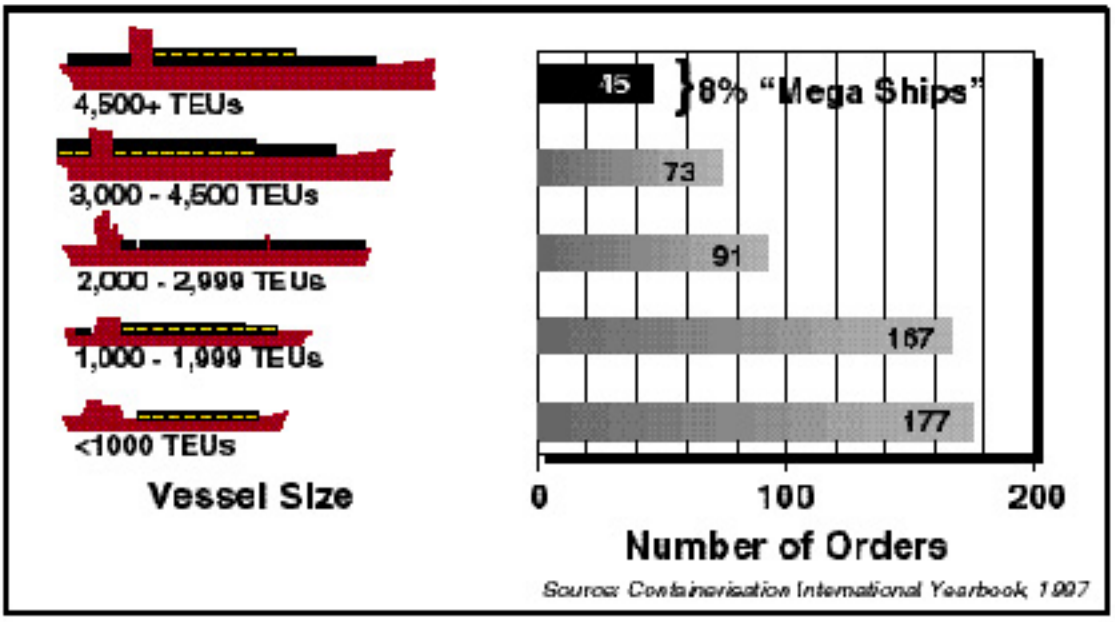
For our Nation to preserve and enhance its competitive position in world trade, we must reduce the cost of transportation by eliminating inefficiencies. How transportation inefficiencies can be reduced was at the crux of the megaship meetings, as was the dilemma posed by conflicting demands for increased investment in a fiscally-constrained environment.

World Containership Fleet as of November 1996



Source: Containerisation International Yearbook, 1997

World Containership Orders as of November 1996



A technical appendix at the end of this report presents background information summarizing aspects of transportation infrastructure, market trends, and transportation planning that must be considered in developing an appropriate response to the introduction of megaships. This background information was mailed to regional participants in advance of the meetings to acquaint them with the issues that would be addressed and the factors that were thought to be relevant to the discussion. Readers interested in more technical information pertaining to the introduction of megaships should refer to the technical appendix.

Regional Issues

Pacific Region

The first of four regional meetings on the megaship issue was held in Seattle, Washington, on March 20 and 21, 1997.

By 2010, the West Coast could see as many as 46 megaships operating in trans-Pacific service to Long Beach/Los Angeles, Seattle/Tacoma, and possibly to other U.S. ports such as Oakland and Portland if they can be dredged to accommodate these vessels. Port representatives were especially interested in seeing what the trends in integrated intermodal movement will be, and determining what should be done to change their terminals. The critical issue expressed at this meeting was "How can transportation facilities handle the large numbers of containers associated with megaship calls?" Transportation industry officials at the meeting pointed out that economic growth will be determined by how well they are able to get freight off the docks and through the system. For participants at the West Coast regional meeting, cargo peaking was a very important issue as were strategic trade corridors and integrated movements.

There are approximately 17 million people in the Los Angeles metropolitan area—the second highest concentration of consumers in the nation—and this market base determines that the San Pedro Bay ports of Los Angeles and Long Beach are likely candidates for vessel calls by megaships. In 1987, the Ports of Los Angeles and Long Beach developed a macroeconomic forecast for 2010 that assumed 6.8 percent growth annually based on the stability of the local, regional and international economies. The Ports of Long Beach and Los Angeles looked at the forecast five years later and found the projections were well below the real rate of growth. Growth in the carrier business over the last decade has created problems in keeping up with the demand. The San Pedro Bay ports have a $2 billion growth plan for the next five years. It is possible that projections today could be below the real rate of growth five years from now.

The Port of Oakland is experiencing many of the same problems as the San Pedro Bay ports, and is committed to maintaining market share and enhancing its marketing position among West Coast ports. The port's perspective on megaships is that if it can't get the biggest ships, it wants to attract business as a transhipment port serving smaller vessels and handling intermodal freight. The Port of Oakland is reconfiguring its terminals and spending $100 million in infrastructure improvements just to serve its existing clients. Oakland representatives said that port development was severely constrained by a lengthy process to secure approval for dredging, but was able to create wetlands at the Sonoma Baylands with its dredged materials.

The Port of Seattle is building three new container facilities, dredging alongside existing berths, and making other capital expenditures to absorb a projected annual growth of 2.4 percent. The Port of Tacoma forecasts 3 to 5 percent annual growth over the next five years. Many attendees from the Pacific Northwest said that the Ports of Seattle, Tacoma and the entire Puget Sound need to be viewed as a single entity serving the northwestern trade corridor. The ability to improve freight rail service at higher speeds was made problematic by large numbers of at-grade highway rail crossings—grade separation work in Washington State alone

Water Depth and Throughput—Pacific Ports

Port	Channel Depth	Berth Depth	1996 Throughput (TEUs)
Anchorage	30-70	35	337,770
Vancouver, B.C.	50	40-50	616,692
Seattle	175	40-50	1,473,561
Tacoma	40-50	40-50	1,073,471
Portland	40	40	302,171
Oakland	42	35-42	1,498,202
Los Angeles	45*	45	2,682,802
Long Beach	76	35-50	3,067,334
Honolulu	45	40	453,044

*50' project underway

Source: AAPA and Containerisation International Yearbook

was projected to cost $900 million. Conference participants from the Pacific Northwest were also concerned that northern tier rail service in the United States is less reliable in winter than rail service through Canada which has better track maintenance.

It was emphasized that the linking of intermodal freight for U.S. trade corridors needs to be seamless if American ports are to remain competitive. Representatives from the West Coast said that cargo is moving to Vancouver, British Columbia due to inadequate rail service and highway connections to U.S. ports. Attendees believed that Canadian port development has benefitted substantially from improved rail connections. Delta Terminal in Vancouver is Canada's newest marine rail terminal and transports 75 percent of its intermodal freight by rail. The Canadian rail system parallels that of the United States and runs uninterrupted east-west from Halifax and Montreal to Vancouver. Representatives from the Ports of Seattle and Tacoma believed they would lose business to the Delta Terminal, which has rail connections across Canada and down through Minnesota to Chicago.

While it is too early to tell whether the new Delta Terminal is attracting traffic that had been going to U.S. ports, it is important to note that a shipper's cargo routing decisions are influenced by a number of cost and service factors, whose relative importance will vary by carrier and trade route. These factors include cost, reliability, security, loss and damage, special handling requirements, and diversification of transportation options. The last factor refers to the fact that some shippers prefer to use multiple carriers and ports of entry in the same trade, because they feel this option will provide more competitive rates and reduce the risk if disruptions occur in the distribution chain.

At the West Coast regional meeting, the Washington statewide transportation plan was used as an example of how conventional transportation planning may need to be expanded to consider demands created by megaships. Large-scale intermodal planning will force planners to consider the role of State transportation agencies in supporting transportation infrastructure that it may not own and operate. Meeting participants struggled with the issues of "What is the State's interest?" and "What could the State do with facilities that it does not own or operate?" Washington State DOT representatives said they had found that there is a State advocacy role in some projects where the State has no direct role but does have a definite interest. These representatives saw the need to develop a strategic spending plan, and are looking into ways to overcome boundary jurisdictions and trust fund restrictions to do this. However, those at the West Coast meeting were unanimous in their belief that tools must be developed to help local and State transportation agencies make decisions beyond local parochial issues.

Gulf Region

The second regional meeting on megaship issues was held in Houston, Texas, on June 17 and 18, 1997.

Although the Gulf region has the smallest intermodal market base of the designated four regions, demand-driven shipping forecasts project that ports in this region will experience the strongest growth in containerized trade. In the Gulf region, eight of 10 states

Water Depth and Throughput—Gulf Coast Ports

Port	Channel Depth	Berth Depth	1996 Throughout (TEUs)
Houston	40*	38-40	794,481
Gulfport	36	36	153,470
New Orleans	36-45	35	261,007

*45' project underway

Source: AAPA and Containerisation International Yearbook

have coastlines and/or extensive river systems. A north/south corridor from the Gulf to Chicago is projected to develop to take advantage of Central American, South American and Caribbean trade. Over the next decade, NAFTA will increase freight traffic within the United States, especially in north/south rail corridors. Analysts believe that the South American market—particularly the East Coast of South America—has proven its maturity and will continue to become more robust. If the Cuban embargo is lifted, there will be tremendous opportunities for growth. There is an initiative in 13 Southeastern states, including 10 states in the Gulf region, to examine freight movement scenarios between that region and Central America.

If megaships do make ports of call within the Gulf region, there is not enough data on landside access, infrastructure, and transshipment scenarios to accurately gauge the potential impacts of their arrival within this region. Participants in the Gulf regional meeting observed that there will be winners and losers if there is a market for one or two ports to accommodate megaships in the Gulf of Mexico. While winning in this case would result from attracting more business, the participants also saw a significant downside because there will be major infrastructure problems that the "winning" port must face. Those in attendance felt that if a Gulf region port wins the status of being called upon by the megaships, the other ports would become feeder ports. Many in the audience predicted that megaships operating in the Gulf region would not target Houston as a hub port or transshipment point, but as a feeder port that serves as a gateway to inland access.

Representatives of ports in the Gulf region thought that their best strategy would be to focus on unique niches where they could capitalize on their capability to move selected cargos. Gulf port representatives saw advantages in positioning themselves as feeder ports that would capture freight traffic emerging from new trade flows. These participants saw the importance of anticipating the service needs of shippers who would be thinking "How do I take new commodities and move them inland to Chicago or other destinations as the markets change?"

Some of this advanced service infrastructure is already in place. The Port of Houston has its own freight information system called FAST, which is tied to the carriers, railroads and truckers to let them know the status of freight shipments. The port places a computer terminal in the office of high volume carriers and communicates with them through electronic data interchange (EDI). For smaller carriers, the port uses a fax system. Nearly 50 percent of Houston's container traffic has gone paperless.

Attendees at the Gulf regional meeting saw problems resulting from railroads not sharing information with truckers. Ports had to assume the role of communications broker and give truckers and railroads a number to call to find out if a shipment is available for pickup. To do this, the ports have to access information from the importer and the carrier and merge the data from the two. Gulf ports also are working on a system to build information from the exporter and importer to incorporate all the different incoming data. There are different database and information systems for different modes, but all of the ports are working on a unified manifest system based on electronic interfaces with the carrier so there is no need to deal with a manifest.

Among the states with progressive freight planning programs, Texas has created a port advisory committee to advise ports on surface transportation improvements and planning activities that should receive their attention. One-stop shopping is being developed for motor carrier permits. The state also has adopted a procedure for pre-processing trains crossing Texas bridges at border crossings that increases the amount of traffic that can be handle by the unobstructed bridge. Trains are moved off the bridge and into a rail yard where Customs Service agents inspect every container in every shipment. Trains can be preprocessed 72 hours in advance and money exchanged between consignee and shipper at the border.

North Atlantic Region

The third regional meeting on megaship issues was held in New York City on July 9 and 10, 1997.

In the North Atlantic (Baltimore and north), market analysts have forecast the development of 7 or 8 megaship berths to serve North Atlantic shipping lanes and the largest customer base in the country. Although the impact of megaships on the East Coast is projected to be significantly less than on the West Coast, East Coast port capacity (including channel depth, terminal storage, and crane capability), and the supporting surface transportation system, would be hard-pressed to meet the traffic surges created by the arrival of megaships. Even if the ships themselves don't call on U.S. ports on the North Atlantic coast, the ports will have to handle larger volumes of megaship cargo through transshipments because this region is a major consumer market.

Dredging was perhaps the paramount issue confronting the North Atlantic ports, with the possible exception of Baltimore. The inability to timely and inexpensively dredge was seen as a federally-created problem. Port representatives felt that rules for disposing of dredged material had been changed in the course of their application for permits, and that they were being held to more exacting standards than at any time in the past. Toxicity of dredged material is now being measured down to the level of parts per million—levels that weren't even measurable a decade ago. Ocean disposal sites for dredged materials have been closed, and meeting participants were concerned that ports couldn't sustain current costs for disposal on land. Participants challenged the Federal Government to find cost-effective ways for ports to dispose of dredged materials.

Meeting attendees viewed the process for securing dredging permits as being unacceptably long. Much of this delay, however, results from shortcomings in planning by ports, States, and Federal agencies for the management of contaminated dredged material than regulatory and testing requirements. In the case of the New York/New Jersey Harbor, the disposal of contaminated dredged material is further complicated by the difficulty in reconciling the economic and environmental needs and desires of two States and numerous local governments.

To accommodate megaships, meeting participants were told that the 40 and 45-foot channel depths of today might have to go to at least 50 feet in the future, because 40 to 46 feet will be the maximum draft for fully-loaded megaships. Several people in the audience noted that waves in the water may change requirements for the channel depth and that water passing under a ship's keel also creates wave damage to the channel. As a result, it is likely that megaships will require 50 feet of channel depth, with equivalent depths for turning, moving, as well as docking.

In the North Atlantic regional meeting, a number of attendees commented that the Conrail divestiture has reawakened States to the importance of freight issues. Metropolitan Planning Organizations (MPOs) are beginning to hear from cities about goods movement because it is becoming an increasingly visible economic issue for the cities. Meeting participants also noted that there is a growing awareness among MPOs that freight transportation goods movement transcends local interests. Issues that previously had been of interest only to ports, such as dredging, are now being raised at regular MPO meetings. Those at the meeting were concerned, however, about the lack of coordinated

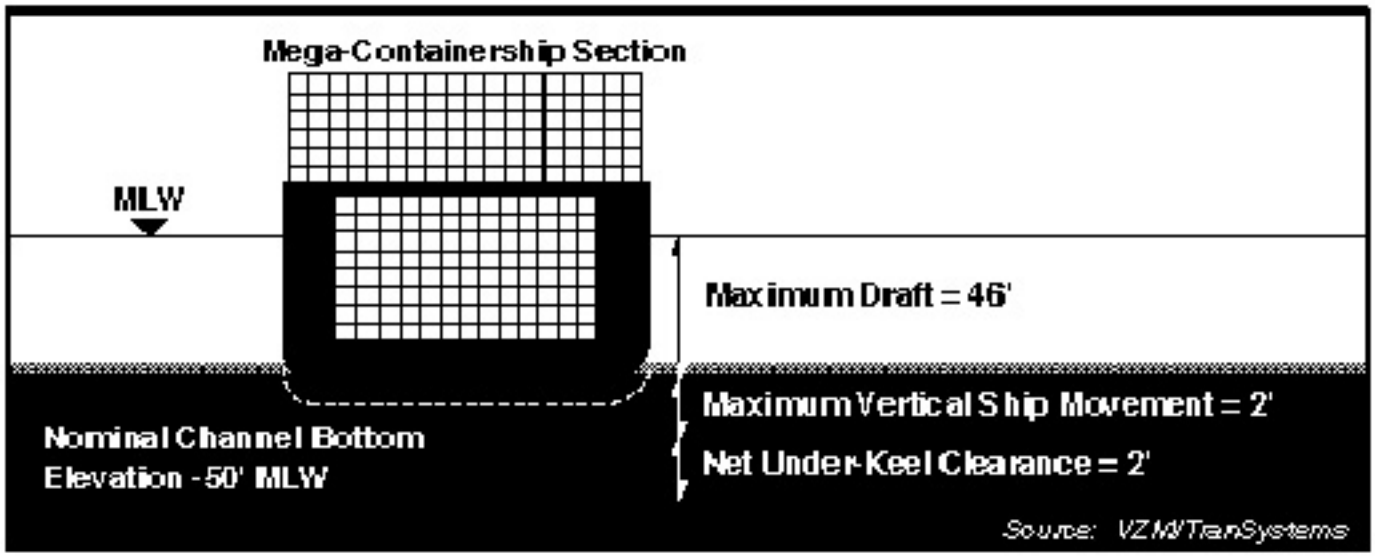
Water Depth and Throughput—Atlantic Ports, Northern

Port	Channel Depth	Berth Depth	1996 Throughput (TEUs)
Montreal	36	35	852,530
Halifax	60	45-47	392,273
Boston	40	40	127,087
NY/NJ	40*	35-45	2,269,500
Philadelphia	40	40	95,086
Wilmington, DE	38	38	162,884
Baltimore	50	36-42	474,816
Hampton Roads	50	32-45	1,141,357

*45' project authorized

Source: AAPA and Containerisation International Yearbook

Channel Design Depth for Mega-Containerships



effort to bring all of the forces together because the state governments in the North Atlantic region have their own agendas and issues. The need for a coordinated regional effort was considered vital in addressing transportation impacts associated with changes in ship design.

Speakers noted that while transportation was recognized as a key to economic development, highway freight movements often have difficulty in reaching urban destinations because of automobile traffic. For example, New Jersey DOT has worked with other state and local agencies to put dedicated truck corridors within railroad rights of way in abandoned industrial areas, or "brownfields". By using brownfield rights-of-way for roads to ports, truck traffic could bypass heavy commuter traffic. Under one proposed plan, truck trips from a port to a rail terminal would take 15 to 20 minutes as opposed to the 45 minutes to an hour on crowded roads. Support from the railroad and state trucking association was seen as critical in advancing the project.

In addition to physical infrastructure improvements to increase transportation system capacity, improved communications technology was cited as offering potential capacity improvements. Terminal operators spoke about the recently installed gate systems that use computer character recognition technology to read tag numbers as containers enter terminal gates. This information is automatically transferred to the office for processing, along with driver's license, truck registration, truck safety, and tax payment information. The investments are made by the user, the chassis owner, and the terminal operator who also are the primary beneficiaries. It was suggested that the consortium of States belonging to I-95 Corridor Coalition could use this technology to track containers through the corridor.

Those at the North Atlantic regional meeting noted that Electronic Data Interchange (EDI) would be useful in conveying other information, such as container contents and cargo weight that would meet requirements of the Intermodal Safe Container Transport Act of 1991. Container usage is sensitive to fluctuations in freight rates which will determine whether a commodity is shipped breakbulk or in containerized units. General cargo is being converted to containers and consolidated cargo shipments are getting heavier, resulting in increased average loaded weights of containers. Conference participants saw potential benefits in using electronic data interchange to transmit information on container weight and content throughout the transportation chain from shipper to terminal to drayman.

Speakers noted that resolving the problems facing ports has been made more difficult by the proliferation of agencies and regulations. As a result, those ports with the most streamlined authority often find it easier to make infrastructure improvements. The Massachusetts Port Authority used this streamlined authority to convene multiple regulatory agencies and gain approval for an eight point strategic plan that included, among other things, channel dredging, rail tunnel reconstruction to accommodate double stack container movements, and the construction of an inland warehouse facility. The Port of Boston would like to work with The Port Authority of New York and New Jersey to create a regional gateway to handle cargo moving in the North Atlantic shipping lanes.

South Atlantic Region

The last of four regional meetings on megaships was held in Norfolk, Virginia, on July 23 and 24, 1997.

Market projections forecast that growth in maritime shipping could support 5 to 6 megaship berths to serve South Atlantic shipping lanes. For meeting attendees, the basic question was "What is the largest vessel that is likely to call on an East Coast port?" If megaships do call on U.S. ports on the South Atlantic Coast, meeting participants believed that there was an opportunity for major transportation providers (ports, ocean carriers, railroads, highway agencies) and users (DOD, metropolitan areas, shippers) to determine where a hub port on the East Coast will be.

The implications of major changes in trade corridors and shipping practices received a great deal of attention at the South Atlantic regional meeting. Participants noted that as markets move further west to India and China, gateways for intermodal freight traffic in this country could move from the West Coast to the East Coast in response to rising costs at the Panama Canal, the inability of post-Panamax vessels to transit the Canal, and overland transit times to the East Coast. They observed that it costs the same to carry cargo from Hong Kong to Los Angeles as it does to ship it by rail from Los Angeles to New York. A few years ago the Far East center of manufacturing was in Japan and Korea; today the centroid is Singapore. The manufacturing centroid also could move to China or India where textile production and manufactured goods are growing rapidly. If the centroid moves to the Indian sub-continent, an increased percentage of freight traffic could arrive on the U.S. East Coast by way of the Suez Canal.

Neptune Orient Lines, for example, uses ship movements through the Suez Canal and found that it could reach the U.S. East Coast in 2 to 4 days less than its conventional trans-Pacific route using transcontinental rail from the West Coast. If there is service to the East Coast via the Suez Canal, the cost of transcontinental railroad shipment is eliminated. Four years ago, only 1.5 percent of U.S.-bound traffic went through the Suez Canal and today that figure is 6 percent. It is unlikely that Suez traffic will overtake Pacific traffic, however, because there is insufficient back haul cargo to transport on the return trip through the Suez Canal. This, of course, could quickly change as cheaper back-haul rates could spur increased market demand for U.S. and Mediterranean export cargo.

Large-scale transshipment ports that could handle megaships also are being considered for Freeport, Bahamas; Kingston, Jamaica; Puerto Rico; and both coasts of Panama. Ships calling on these transshipment hubs will be responding to developing markets and changing trade flows. A Freeport transshipment hub would take advantage of market development of the East Coast of South America. Freeport also is a good choice for a hub because it has sufficient harbor depth and labor costs are lower than in U.S. East Coast ports. By comparison, San Juan, Puerto Rico has higher harbor costs and only a 35' depth. San Juan, however, does have very good throughput capability through its MIT terminal and could become a hub for transhipment to the U.S. Gulf Coast and Mexico.

Many participants at the South Atlantic regional meeting said that the military could play a major role in proactively determining the location of a U.S. transshipment port to handle megaships. In the current

Water Depth and Throughput—Atlantic Ports, Southern

Port	Channel Depth	Berth Depth	1996 Throughput (TEUs)
Wilmington, NC	40	40	103,579
Charleston	42*	40	1,078,590
Savannah	42	42	650,253
Jacksonville	38	38	613,448
Palm Beach	33	33	174,870
Everglades	47	37-44	701,281
Miami	42	42	656,798
Freeport	47	47	new terminal
San Juan, PR	35	35	1,640,624

*45' project authorized

Source: AAPA and Containerisation International Yearbook

environment of military downsizing, there is an initiative from the Department of Defense United States Transportation Command (USTRANSCOM) to find out whether ports would be interested in developing land on military bases in exchange for agreements to give the military access for training exercises or staging activities during times of national emergency. In addressing the question of developing a superport on the South Atlantic Coast to handle megaships, the military considers the infrastructure for megaships to be excellent infrastructure for military deployment.

The South Atlantic regional meeting also addressed operational challenges of a regulatory nature. A number of participants stated that shippers were frustrated by U.S. Customs Service procedures for clearing cargo. As recently as 10 years ago, U.S. Customs agency personnel couldn't get proper information associated with containerized cargo. Today, U.S. Customs gets about 99 percent of the information on cargo movement. The problem remains for the ports to match the information on the paper to the contents of the containers. Conference participants strongly urged that the process of clearing cargo through Customs be expedited, although it appears that the problem often lies with shippers not providing information in a timely manner on containers destined for export.

Port representatives felt challenged by what they regarded as antiquated requirements to move cargo to meet Customs' needs. The representatives questioned why they should have to ship containers to another location for the Customs' inspection when the containers could be checked at the port of entry. Under the present system, attendees saw no need for the double handing of containers. Participants felt that such double handling benefits only the transportation brokers when containers are shipped to another location to be inspected before they can be sent to the customer's door. Customs Service officials felt that information systems alone could not guarantee container contents, nor could they station inspectors at every port, so ultimately some cargo will go elsewhere for inspection.

Many meeting participants felt that because ports create jobs, decisions on port dredging were made on the basis of political clout versus competent market analysis. Attendees noted that there was prioritization employed in compiling the Base Realignment and Closure (BRAC) list for military installations. It was suggested that the politically driven decisions on specific dredging projects could be taken out of the hands of individual congressmen by using a process analogous to that employed for the BRAC program, where Congress had to vote either up or down on the entire list of bases proposed for realignment or closure. These participants suggested that using a similar system for our ports, the U.S. could force decisions for national investments to accommodate megaships. But as a prerequisite to making the list and evaluating the choices, decisionmakers would have to be given a total systems perspective using an analytical model that has yet to be developed.

ON ACCESS TO PORTS

"Our transportation system, after all, can only be as strong as its weakest link, and so we need to ensure sound access to our ports. The principles and programs of NEXTEA do that, and we want to see them incorporated into the final bill that Congress passes and implements, as well as by a DOT that has incorporated Secretary Slater's vision of a 21st century transportation system that is international in reach, intermodal in form, intelligent in character, and inclusive in its service."

Mortimer Downey
Deputy Secretary of Transportation,
addressing the
American Association of Port Authorities Convention
September 23, 1997

Cross-Cutting Issues

The previous section has attempted to capture major regional issues and activities that were highlighted at each of the four regional meetings. This section presents broad, cross-cutting areas of discussion that were common to all of the meetings. These eight topical areas were: Market Prediction, Public Involvement and Education, Planning Perspective, Port Capacity, Intelligent Transportation Systems Applications, Data Needs, Labor Issues, and Regulatory Issues. It should be noted that many of these issues are not unique to the introduction of megaships, but reflect the transportation challenges associated with dramatic increases in international freight movement.

Issue Area—*Prediction*

Proponents of megaships contend that historically, demand often does not surface until a product is introduced. On the demand side, there is rapid change in the products and services that are introduced into the market and those that are replaced. The challenge for transportation providers and enablers becomes one of adjusting a fairly static transportation system to meet future needs. Product demands and services change quickly, but because of large capital-intensive infrastructure investments, improvements to the transportation system require much more time. Market uncertainties are, by nature, greater than technological uncertainties. The central question addressed how intelligent transportation investments could be made in light of this environment of uncertainty surrounding megaship calls.

The issue of how changes in ship design (megaships) would impact transportation infrastructure and operations was further broken down into subordinate questions: will we see megaships, where will we see them, how many of them will we see, and when will they come? Some meeting participants questioned whether the trend towards increasing ship sizes will continue ever upward. They contended that not all carriers are persuaded by the economies of scale of megaships and noted that there are actually diseconomies for loading, unloading, and accommodating small, diverse, or expedited cargoes carried by these ships. Some carriers have made a decision to stay with a 3,500 TEU maximum on their ships.

Meeting participants were unanimous in their agreement that if larger carriers elect to use megaships, these ship deployments will have a ripple effect throughout the fleet. Attendees saw three possible market scenarios developing in international waterborne commerce:

1) Megaship markets with larger concentrations of cargo;
2) Fastship markets with smaller concentrations of time-sensitive cargos (the cargo "conveyor belt" analogy); and
3) Major residual markets where service by medium to small ships would predominate.

Some industry analysts have called for studies of megaships using analogies of the unsuccessful deployment of large oil tankers commissioned in the 1960s and

How Big Will Mega-Ships Get?

	TEU Capacity	Length Overall (Ft.)	Beam (Ft.)	Maximum Draft (Ft.)
HDW CS 5860*	5,864	905	131	46
HDW CS 6800	6,800	1,000	131	46
HDW Propoeed "Jumbo"	8,000	1,099	151	46
P & O "Flight of Fancy"	15,000	1,312	226	46

Source: AAPA, HDW and P & O Containers

* HDWARLDTSWERKE-DEUTSCH WERFT AG

19/Us. Uthers observed that today's ships don't tend to be fully loaded (ships generally sail 85 percent loaded) and questioned if there was sufficient cargo to justify megaships. Currently, there are more ships in service than there is freight to fill them, with some estimates ranging as high as 50 percent overcapacity among steamship lines. Those who urged caution in accepting predictions calling for the introduction of ships of ever increasing size noted that there is a point where ships will become too big, and then the operating costs will go up and/or they will find there is simply too much inventory or assets tied up in one place at one time. At some point, larger megaships could off load more than anyone could handle and pick up more than anyone could deliver.

Another technology discussed at the regional meetings was the "FastShip" concept. FastShip Atlantic, a Virginia company, has developed a container transport system which utilizes new vessel technology and new loading/unloading technology to provide much faster transatlantic service (3.5 days) than either current containerships or next generation megaships (8 days). The FastShip vessel will be smaller than a post-Panamax vessel (770 feet in length, 110 feet across the beam, and carrying 1,320 TEUs per vessel) but will operate at up to 45 knots (as opposed to 25 knots for post-Panamax and megaships). In port, the FastShip will not be loaded using conventional cranes—instead, strings of loaded railcars will be moved on and off the vessel, which will be berthed at the stern. FastShip is currently in the testing stage.

Some participants observed that even if the Federal Government does nothing, the market will take its course. They noted that Federal money has been squandered on projects that attempted to anticipate markets that didn't develop. These participants cautioned against Federal cost-sharing programs or grants targeted to develop megaship ports. The attendees espousing this point of view believed that public entities and the private sector will invest in the megaship ports if there are economic benefits. The question becomes one of whether the ship operators will participate in paying for the development of port infrastructure to handle their ships. The challenge to transportation decisionmakers is to consider differences between the commercial life and operational life of an investment—what is the likely long-term impact of investments made to increase transportation capacity to accommodate potential port calls by larger and/or faster ships?

Issue Area—*Public Interest and Education*

Many of those present at the regional meetings commented that the public doesn't see the need for tax increases and project development to support freight movements. This lack of transportation awareness was characterized as an education problem for Federal, State, and local audiences. The public was seen as not understanding the importance of freight movement to their economy or quality of life, or how transportation systems work. Many attendees noted that the MPOs and elected officials have to be educated as well to raise their awareness of these issues. Nevertheless, participants believed that these messages can be conveyed if you get shippers, carriers, truckers and terminal people together to talk to the general public.

Speakers observed that difficult problems are associated with getting the public to finance larger scale projects of regional or national significance. People were seen as being willing to tax themselves for local projects that promise specific improvements to their lives, but the public often can't be sold on building something to benefit other jurisdictions. Such projects

require an enormous amount of public education through cooperative efforts of planning agencies and industry. The public must be informed about the consequences of larger scale air quality degradation, traffic congestion, accidents, and higher costs of goods and services if transportation improvements are not made. On the issue of corridor investments, U.S. DOT representatives noted that the Administration's legislative proposals for surface transportation legislation contain funding for trade corridors and freight projects through regional coalitions for economic development, although privately-owned rail corridors remain ineligible for Federal funding for infrastructure improvements.

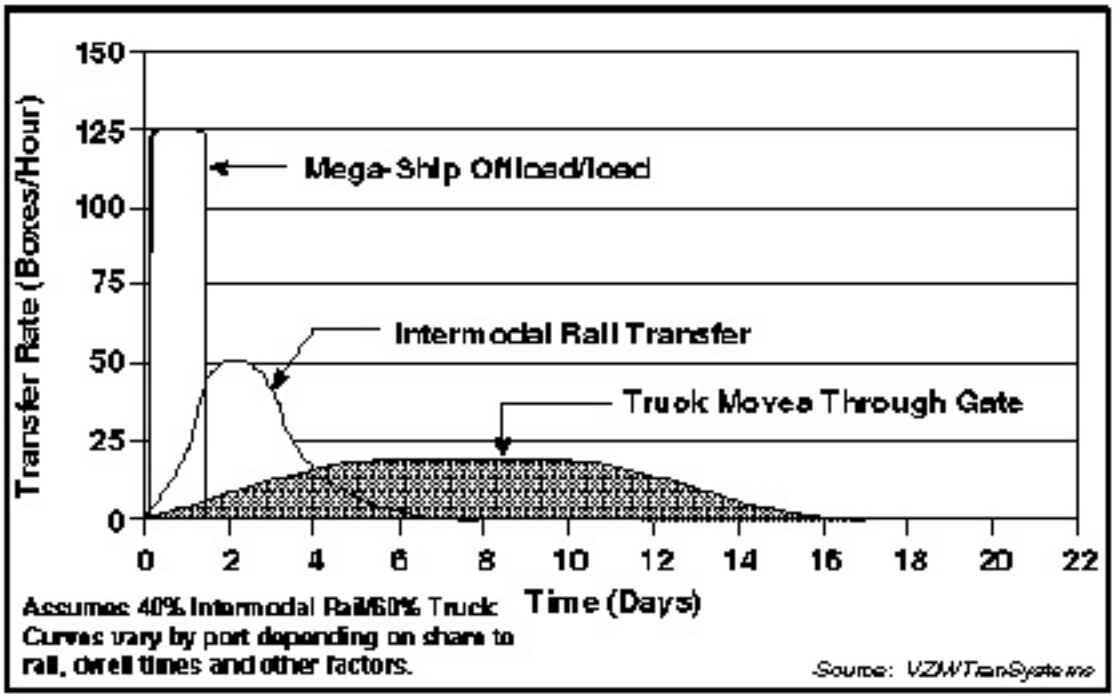
The importance of formal education programs addressing freight transportation and intermodal practices also was raised at the regional meetings. Industry representatives acknowledged that few universities have programs dealing with transportation, logistics, and freight market dynamics. Most people who currently are employed in the intermodal industry came up through the ranks. In the future, ports and the transportation entities that serve them are going to need a more structured approach in developing highly qualified people. Increased emphasis needs to be placed on logistics to teach young people how to build and operate integrated transportation systems. The work done in the freight transportation industry is typically conducted without the general public having any idea about what goes on through these operations or in these facilities, or how it affects them. During the meetings, USDOT representatives pointed out that the Department has set an education goal to inform 1 million young people about transportation and technology career opportunities.

Issue Area—*Planning*

Conference participants felt that a systems view of planning to address megaships was appropriate. Attendees felt that there are two differing planning processes that have to be resolved—State planners typically have a 5- to 10-year planning horizon, while the operating horizon of a carrier is typically of shorter range. Longer range planning is usually not shared with port service providers. Somehow these planning and operating horizon discrepancies must be reconciled.

From a planner's point of view, current and proposed legislative programs that would fund intermodal projects do not have enough money. The States are concerned that they will have less flexibility and less money for freight projects that are essential to the economy because other programs for public transit, bicycle paths, demonstration projects, and the like will dilute funding. Many States don't have matching funds to make adequate use of innovative financing techniques, such as State Infrastructure Banks, so projects get postponed for years. Furthermore, some projects are constrained because of State laws that earmark fuel tax moneys for highways and highways only. A number of participants at the regional meetings saw opportunities in expanded partnering and cooperation between ports and the military. The military has assets that are useful commercially and militarily, as do ports. Department of Defense representatives commented

Mega-Ship Terminal Peaking Characteristics



that the military's Transportation Command (TRANSCOM) has an initiative to determine if the ports would be interested in shared use of military facilities in exchange for agreements to handle the military's needs for training exercises or in times of national emergency. These participants noted that the infrastructure required to handle megaships appears to highly compliment the infrastructure for military deployment. South Atlantic ports like Charleston and Norfolk are considering the shared use of military facilities. In the Gulf region, Gulfport is looking at a partnership with the military to develop an inland intermodal facility that also would serve as a staging base.

There were a number of participants in the regional meetings that argued that the Federal Government should not be in the business of targeting national investment in areas such as port development because these facility operations respond to local and market-driven issues. Other participants noted that public/private partnerships in planning and investment are good, but they can blur the lines between the regulator and the regulated. It then becomes difficult for Federal and State agencies to regulate private sector partners because they have different roles and different goals. The private sector's goal is to profit and grow, while the public sector is concerned about ensuring the public good. Conference participants offered that Federal agencies could make a significant contribution to planning efforts by sharing success stories of public/private partnering so that they can be copied.

Issue Area—*Port Capacity*

The four regional meetings generated a significant amount of discussion about transportation system capacity, how to define it, and how to determine how much capacity was needed. In general, reducing container dwell time by one half will increase terminal capacity two-fold. Container dwell time in U.S. ports averages 6 to 8 days (in some places it is 30 days) and in rail intermodal terminals it is 1-1/2 to 2 days. Reducing dwell time can effectively increase port capacity because storage area becomes available for increased handling.

Virtually all of the meeting participants agreed that there is reserve capacity in U.S. ports, but this capacity could not be tapped under existing operating practices nor is it necessarily compatible with the capacity of supporting landside transportation networks. Further capacity enhancements would be possible through operational changes such as working on weekends, but these changes are not without their costs. The schedule under which cargo is unloaded is a guiding factor, and cargo peaking usually is factored into shipping lines' ship call strategies. The dynamics of what cargo gets priority loading is a sensitive and very politicized issue.

The issue of why lengthy dwell times occur is more complex than the simple metrics of time and speed. Some shippers dwell containers in a port because it doesn't cost them anything to store them there. Dwell times also vary from port to port as a reflection of modal splits. Ports that rely more on highway transport of containers tend to have higher dwell times, while ports with on-dock or near-dock rail service tend to have lower dwell times. If the modal splits are changed to reduce dwell time, then terminal operations to handle throughput are changed.

Moving more freight to rail increases terminal capacity. On-dock rail facilities were seen as one effective strategy for dealing with port terminals with constrained throughput because such facilities take traffic off congested city streets surrounding the port and put it onto rail. Reductions in drayage, handling costs, transit times, and on-site storage are the reasons for having rail connections to the dock. A recent Maritime Administration study found that simultaneous interchange between container ships and container trains could achieve a 30% cost savings in operating expenses.

The terminals are deploying technology to speed trucks through clearance processes. Information systems provide up-to-the-minute information using fiber optic systems and computer character reading technology to read tags on moving vehicles, and this has increased terminal throughput dramatically. The terminal operators are motivated to increase their throughput because it means they can handle more business and do so at lower costs. Efficient gate systems are crucial to overall port efficiency.

Issue Area—*Intelligent Transportation System Applications*

Comments were made at every regional meeting that applications of Intelligent Transportation Systems (ITS) technologies could help achieve greater port terminal efficiencies. Maritime industry representatives noted that recent research has shown that ports could reduce the size of their terminals by almost 30 percent if container information could be managed better. Many port officials commented that they have had integrated ITS systems for some time, but problems arise due to incompatibility between modal and customer systems using transponders and reader technologies. For example, systems utilized by trucking companies are totally different from those used by ports. Many people in the private sector felt that there will be rapid deployment of ITS once the compatibility issues are resolved.

The commercial market has technology available today that allows trucks to move from State-to-State and can track cargo electronically. Technologies allow

ITS Technologies

- Radio Frequency	- Automated equipment
* Global positioning systems	- Visual imaging
- Weight-in-motion	- Terminal operations
- Electronic data interchange	- Load planning

for tracking the intermodal movement of containers to remote distribution points. Rail data systems are rather sophisticated compared to those in the trucking industry. Several participants observed that 98 percent of all U.S. rail cars have radio identification technology (transponder tags) onboard. It was possible to incorporate this technology into equipment nationwide because the railroads have an organization (Association of American Railroads) that mandated that tags be used and supervised the transition. Speakers observed that there is no omnibus organization in the shipping industry to mandate that similar actions be undertaken for marine containers.

Some of the attendees raised the counterpoint that while virtually all railcars in the U.S. have been equipped with transponder tags, only 38 percent of the readers have been deployed. The slow rate of deployment reflects, in part, a lack of industry interest in the comprehensive monitoring of rail freight movements. An equally slow rate of Electronic Data Interchange (EDI) deployment for general intermodal container movements could be encountered because not all shippers would see the need to track all containers—especially those that contained cargoes that were of low value or not time sensitive. EDI is expensive, each shipper wants EDI information tailored to their particular operation, and a number of meeting participants doubted that shippers would pay for it. Shippers interested in EDI need to tap into carrier data bases for individualized service. EDI benefits ocean, rail, and motor carriers to control bookings, container movements, etc. allowing customers to share subsets as a by-product. It was suggested that shippers would know that if they waited until the carriers deployed the new technologies, then they can reap the benefits without making the investment. While tracking the movement of containers during international transport was seen to have certain benefits, there were fewer benefits seen in domestic users paying for this service or the cost of security measures for these systems.

Intermodal Information Technology Advances in Seamless Service

- **Wide-range radical customer service improvements are being implmented.**
- **True in-transit visibility information (RF/AEI train monitoring) will become widespread.**
- **Integration with customer logistics systems (contract logistics) is the goal and is sometimes mandated.**

Issue Area—*Data Needs*

The regional meetings generated discussion on several problems associated with current transportation data. One of these problems involved the extent to which data should be relied upon to completely and accurately capture the dynamics of the marketplace. Macro-economic numbers lack sensitivity to near-term fluctuations in the marketplace and cannot predict nuances of consumer demand and supplier response. This problem is further compounded by a frustrating lack of comprehensive, real-time information. Market analysts at the regional meetings observed that there are more current data for international trade than there are for domestic trade flows at the subregional level. These problems were encountered in making projections of future trade flows for U.S. ports using 1995 data and assuming unconstrained circumstances (i.e., ports respond to market demands with unlimited capacity, no recessions or market downturns, etc.).

Meeting participants also asked exactly how information would be used to plan for transportation investments and operations, given that these needs varied among different users. Carriers, Customs Service agents, and port operators have different information needs regarding container contents, their arrival and departure schedules, dwell times, points of pick up and delivery, etc., but there is still the challenge of developing an integrated system that can address all of these information needs. For example, how do these parties find out who filled and sealed each container? If problems arise, how can it be tracked back to the depot and get a deposition of where the box originated? Other comments noted that commercially useful data may, or may not, be useful planning data and that there are major problems in making information that shippers or carriers view as proprietary available to public agencies for planning purposes.

Meeting participants saw little movement towards the integration of divergent information systems. When considering landside and marine transportation operations, there is one set of core information that the ports use, a second set of core information that the truckers use, a third set of core information that the railroads use, a fourth set of information that each customer uses, and a fifth set that the transportation agency uses. Each user wants to choose his own subset of information from all of these sets. When this information is processed using equally unique sets of legacy hardware and software systems, it becomes almost impossible to translate this information. The

International Standards Organization has recommended EDI formats, but there has been no final agreement on standards. Recent advances in electronic commerce and doing business over the Internet hold promise for the future.

Issue Area—*Labor*

Participants at all of the regional meetings commented that while technological advances may offer the potential to increase capacity, the ability to use this technology may be compromised. More specifically, labor and management may be unable to agree on deploying certain technologies. In many other countries, management can simply elect to employ time and labor saving technologies. In the U.S., negotiations between labor and management often must take place first before the technology can be deployed. Industry representatives observed that technology deployment requires consideration of labor, its costs, and the availability of skilled labor. Attendees noted that new information systems may provide opportunities for increasing efficiency, but they simply couldn't throw technology at problems without considering the implications for labor. To be competitive, industry must find the balance between labor and technology.

For example, applications of advanced Global Positioning System, on-board mapping, and electronic driver logs are placing increasing demands on truck drivers to the point where they need special training beyond that needed to simply operate a truck. And these technological innovations are being introduced at a time when the motor carrier industry is short of skilled drivers. But such improvements are necessary in light of responses to surveys of commercial motor vehicle operators that routinely find that waiting in lines at intermodal terminals is a major complaint of drivers; since many drivers are paid on a per-trip basis, drivers want to drive—not wait in line. Technology deployments all share the common goal of reducing paperwork, but require educational programs to be effective.

Attendees at the regional meetings observed that unions are very sensitive to automated handling of cargo, and automation dictates a number of changes. Some work rules are ancient and contracts have to be negotiated that reflect current technology in the marketplace. Many ports are trying to eliminate double handling by eliminating the point of rest in transferring cargo between modes. Ports also are looking into combining "local" locals so contractual discussions and work rules are less fragmented.

Port representatives identified the operational conflicts that result when carriers request that their ships be worked around the clock when they are at berth, but ports can't keep their gates open around the clock. Those attending the regional meetings said that a change in the thinking of union leaders would be required if the unions are going to change their ways of doing business, just as the ports are doing. Meeting participants observed that unions need to be aware that some labor rules could cost the ports and their workers business that will be lost to foreign ports.

The port representatives noted that their business would change dramatically if steamship lines begin to operate seven days a week. Today ports have weekly or biweekly vessel calls—if this situation changes to daily ship calls, ports may have to ask carriers to redeploy or adjust their ship calls. Ports have hundreds of millions of dollars in assets in their facilities, but can use them only certain hours of the day, and are forced to expand capacity because their productivity is so low. Ship activities go on around the clock, but landside activities are limited due to labor contracts and the high cost of overtime pay. Port officials saw some risk in entering into labor contracts with provisions for expanded hours of operation on the chance that shippers will pay more for around the clock service. In the opinion of these officials, the shippers currently seem to be getting the level of service they want to pay for.

From labor's perspective, there was general consensus at the four regional meetings that changes in how ships are loaded and how containers are processed will require new working relationships between Federal officials, port management, labor, and the motor carrier and rail industries. New solutions and work regulations cannot be top-down decisions, but will require participation and input from all parties involved in the decision, including labor. The union representatives also endorsed the views of local officials and port managers that transportation management practices must become more efficient if port facilities and other components of the transportation system are to be able to meet demands of increased freight flows.

Union representatives said that the new technologies and rapid cargo handling needed to service larger ships will require new and more advanced skill sets among dockside workers. Increasingly, these specialized dockside jobs will require the "right" person to be found for the task (such as crane operators), which raises the issue of where will these workers be found and who will train them. Adequate preparation and deployment of these workers becomes a critical issue to a port ramping up for megaship service. While new operating strategies will move greater volumes of containers, labor representatives cautioned that worker safety could not be compromised.

Issue Area—*Regulations*

Meeting participants pointed out that intermodal choke points are not just technological, institutional, or operational—there are also regulatory impediments. Participants observed that the same amount of effort

needs to go into capturing efficiencies through streamlining and simplifying the regulatory process as through technological and institutional/operational improvements. Unless some regulatory impediments were resolved, those attending the regional meetings felt that no major efficiencies will be gained in intermodal transport no matter how many improvements are made in other areas. Regulatory changes may have to parallel the need for facility development in response to market demands.

Transportation officials also saw impediments in complex regulations for making improvements to landside connections to ports. Under provisions of the Intermodal Surface Transportation Efficiency Act of 1991—and prior to the National Highway System Designation Act of 1995 (NHSDA), U.S. ports accessed funds through the Congestion Mitigation/Air Quality (CMAQ) program. A large number of ports are not in non-attainment areas for air quality conformity, which makes them ineligible to receive CMAQ funds. Meeting attendees were frustrated by the disconnect between transportation policy statements that endorsed the need for intermodal infrastructure investment that would facilitate freight movements and the lack of funding authority and regulatory streamlining that make such investments difficult.

It should be noted that the NHSDA identified 240 marine terminal connectors to the National Highway System. This total includes the designation of 104 marine terminal connectors named in the Act and an additional 136 connectors identified in the comprehensive 1996 report submitted to Congress by the Department, entitled "Pulling Together: The National Highway System and its Connections to Major Intermodal Terminals." While status as a designated connector does not guarantee funding, it does provide opportunities for accessing Federal-aid funds.

Perhaps the most daunting regulatory hurdles—and ones that were raised at each of the regional meetings—were the regulations pertaining to dredging. Doing the required environmental analyses and planning for a dredging permit request can sometimes be a very lengthy process in the United States, and conference attendees urged that ways be found to speed up the process. These regulations and testing requirements have their basis in environmental protection standards established in law by the Congress of the United States, specifically in Section 404 of the Clean Water Act of 1972 and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended.

Port representatives believed that the process for securing dredging permits was mired in issues of political influence and appropriations. The participants felt that when politics are introduced and market realities are ignored, the evaluation system breaks down and worthwhile investments are impeded. Comments noted that the Army Corps of Engineers goes through an extensive feasibility study before acting on permit requests, and this can take a considerable period of time when complex issues are involved. When transportation officials hear about developments like the coming of megaships, a considerable amount of time is required to do the necessary planning and secure the requisite permits before improvements like dredging can be made. Even after the Corps develops its information, meeting attendees felt that the political debate fails to give it adequate consideration in the decision making process. The Corps has pointed out, however, that in Fiscal Year 1997 the Corps completed about 80 percent of individual permit actions within 120 days and, when both individual and general permit actions are considered, over 90 percent of these actions were completed within 60 days.

In addressing issues related to dredging, it is important to note the distinctions between the two basic Federal dredging programs managed by the Corps: (1) new construction (i.e., the dredging of a deeper channel depth for a project), and (2) maintenance dredging (dredging to maintain existing project depths, including emergency dredging) and the regulation of non-Federal dredging activities, such as berthing areas and non-Federal channels. Projects within these programs are evaluated and authorized (or approved) under different procedures, and the Federal programs are funded from separate appropriations accounts. These distinctions, and the recent progress made by Federal agencies in cooperating with various dredging stakeholders, will be critical elements in future discussions of dredging issues.

One of the regulatory impediments cited during the regional meetings was the Jones Act. The Jones Act requires that vessels moving cargo between two U.S. points be U.S. built, flagged, and crewed. Cargo transported by water between two Canadian ports must also go on a Canadian-flagged ship. Respondents also felt that tax levied against cargo handled by U.S. ports served to divert freight to Canada, which does not have a Harbor Maintenance Tax. They believed that the market will find inefficiencies wherever they exist and find ways to avoid them.

Representatives from the USDOT's Maritime Administration have met with various public and private stakeholders to discuss and identify the potential causes of cargo being diverted from U.S. ports to nearby Canadian ports. Aside from normal marketplace decisions, concerns mentioned focused on dredging and the impact of the Harbor Maintenance Tax. (The Jones Act was never raised as a possible cause of cargo being diverted to Canadian ports, although it was cited as a possible incentive in the development of a potential Caribbean megaport to feed U.S. ports.)

Perspectives of Key Players

The regional meetings on the potential impacts of megaships attracted a full spectrum of transportation professionals. Those in attendance included representatives from steamship lines, port authorities, marine terminals, railroads, trucking companies, metropolitan planning organizations, organized labor, state DOT's, local transportation agencies, and the Federal Government (U.S. DOT, EPA, U.S. Customs Service, Department of the Army [including Corps of Engineers], and Department of the Navy). While all of these parties play a vital role in the international movement of freight, discussions during the regional meetings tended to focus on the activities and perspectives of five of these entities: the ports, the steamship lines, the military (Department of Defense, excluding the Corps of Engineers), the Class I railroads, and the Corps of Engineers. This section presents the comments of the meeting participants on the perceived roles of these five "key players."

Port Perspective

United States ports are governed by a variety of public entities (State, bi-State, or local government agencies), but they operate more like private sector businesses. While many public ports are striving to become financially self-sufficient, most receive some form of assistance from their governing body because of the economic benefits and jobs derived by the local and regional community from port activity. Although individual ports are aggressively seeking new business opportunities, many ports recognize the need for regional cooperation and partnerships with other elements of the distribution chain because shipper routing decisions are based on their total needs—both cost and service.

As public entities that are held accountable for their performance, port representatives recognized that they needed to do a better job of supplying the information that government officials need to make the transportation investments that are so critical to ports. Every port reports to a higher governing authority and that authority must understand the significance of the jobs that are tied to the port's operations. Port representatives pointed out that if they did not accurately anticipate market developments and made the wrong decision on a major investment, the mistake could impede the port's development for 20 years or more. A major port could be relegated to minor port status due to bad decisions.

Ports representatives acknowledged the danger in thinking that if megaships are constructed they must automatically add infrastructure capacity to their port. Ports urged caution in investment in megaship infrastructure, especially for those ports that were likely to be feeder ports. Carriers were seen as being likely to narrow their choices to only two or three ports on each U.S. coast. On the question of whether carriers would be likely to share in the cost of infrastructure investments occasioned by their vessels, port officials noted that carriers have not paid their full share of port infrastructure improvements to date, nor do ship owners typically consult with ports on long range planning for port infrastructure.

Attendees at the regional meetings were very interested in financing mechanisms that could assist ports in making the infrastructure investments required by changes in ship design. Participants believed that Federal measures to provide credit enhancement could entail measures such as grant set-asides that improve a port's credit rating. These credit enhancements were viewed as particularly useful for large projects that have port- related project consequences beyond a State's limits.

Steamship Line Perspective

In an era of increased competition, fewer financial resources, new environmental regulations, heightened safety awareness and a constrained infrastructure, carriers and shippers are turning to new strategies to meet marketplace demands. Carriers are under tremendous pressure to differentiate their services to make them more competitive against their rivals. Restructuring services and targeting new markets have created an environment of constant change for many port/terminal relationships. Carriers have plans on service vessel deployment strategies and routes, but for obvious reasons of competitive advantage they don't make these plans public. The carriers find it to be to their advantage to play ports against one another on the expectation that ports will give the shipping companies favorable deals and build facilities to develop emerging markets.

The carrier industry is consolidating and alliances are being formed at an accelerating rate. Consolidation of liner companies and a reduction in the number of carriers have boosted the size and geographic reach of the remaining companies. Consolidations and alliances have produced economies of scale that individual firms can not reach on their own. These economies have helped save hundreds of millions of dollars through consolidations of staffs, terminals, facilities, and services. This situation has forced smaller shipping companies into niche markets and forced some ports out of the running to serve these larger entities.

This in turn has provided increased leverage for the consolidated companies or alliances to negotiate with those ports that can handle and compete for the traffic. As a result, some ports will loose carrier business until they can gain other customers.

Military Perspective

In Desert Shield and Desert Storm, the military experienced problems in tracking and identifying containerized and noncontainerized equipment and supplies that had been deployed. It is estimated that during Desert Storm, between 20,000 and 25,000 containers arrived and had to be opened to determine their contents. The military has realized that if it can gain better control of tracking containers, it can better control its overall logistics. Some participants in the regional meetings observed that the military brought many of the problems upon itself by declining the offer of shipping companies to use their landside management/in-transit visibility technology that had already been developed for tracking containers and their contents. Generally, military documentation on government bills of lading and tracking systems are not compatible with commercial systems.

After Desert Shield and Desert Storm, it became apparent that the military had a serious logistics problem in monitoring the transport of cargo. The challenge facing the military is to push the maximum amount of material through the transportation pipeline in the shortest amount of time. During Desert Shield and Desert Storm, the military's greatest domestic constraint was rail access at U.S. ports. The military experienced load center congestion, and a lack of staging area for equipment such as tanks and trucks. Some ports were found to lack the space that the military needed to stage its equipment. The military has the same pressures as commercial interests do, where time is of the essence and there are enormous amounts of money tied up in transporting goods.

The military has examined its logistical needs for cargo tracking and has determined that it requires a read/ write standard for transponder tags as opposed to a read-only standard. The military wants to rely on moving its freight via public and private carriers, but shares the view of the intermodal industry that there needs to be greater integration in the information system.

The Department of Defense is interested in getting one military-visible system that is able to communicate to all commercial logistics tracking systems. The military is only 5 percent of most U.S. flag carriers' business and represents a minority share on most market routes. There presently are no plans to construct U.S. flag carrier megaships. Therefore, the market ultimately may drive tagging and tracking technologies in directions counter to those that the military would prefer. Such a development would have the unfortunate outcome of separate and therefore costly investments in tagging and tracking to serve the individual needs of the military and the private sector.

The Military Traffic Management Command (MTMC) is responsible for moving forces through ports under different activation scenarios. At the national level, there is a Memorandum of Understanding (MOU) on Port Readiness that establishes the National Port Readiness Network. This organization provides coordination and cooperation to ensure readiness of commercial ports to support deployments. At each strategic defense port, representatives of the MOU signatory agencies establish local port readiness committees (PRCs). The PRCs work closely with the ports to ensure preparedness and assist during deployments. On a semi-annual basis, the

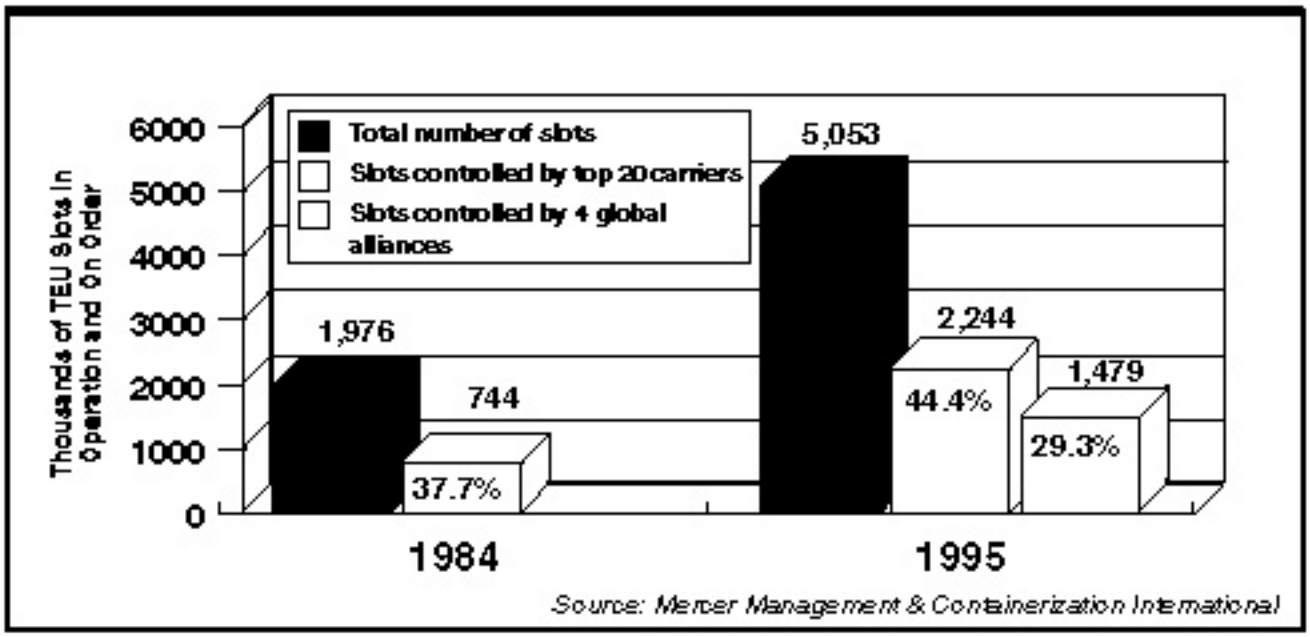
Characteristics of the Mega-Ship Terminal

Acres	150
Berths	2 @ 1,250' for Mega-Ships 3 @ 1,000' for Mixed Vessel Sizes
Cranes	6-10 Beyond Post-Panamax Cranes
Water	50' Channel/Berth Depth; 800' to 1,000' Channel Width; 1,480' to 1,650' Turning Basin
Projected Yearly Throughput*	450,000 TEUs/Yr. Minimum (3,000 TEUs/Acre) 900,000 TEUs/Yr. Maximum (6,000 TEUs/Acre)
Rail Connections	On-Dock or Adjacent Intermodal Railyard, 2-4 Unit Train Calls/Day (40% Intermodal Split)
Truck Traffic, Typical Day	1,730 to 3,460 Trips/Day (40% Intermodal Split) 2,880 to 5,770 Trips/Day (0% Intermodal Split)

* Through the gate – excludes possible transshipment.

Source: VZM/TranSystems

Industry Concentration Has Increased Dramatically, and Will Continue



Source: Mercer Management & Containerization International

Maritime Administration and MTMC visit the strategic defense ports to assess port readiness.

During a deployment, the military may require staging area and berths at the strategic defense ports. The military typically plans for appropriate staging area and berth space to accommodate the simultaneous loading of three vessels. These requirements may reduce a port's ability to meet commercial cargo requirements and cause commercial disruption. The military relies heavily on the ports for a robust and responsive system to meet deployment requirements. The strategic network of highways, rails and ports must be able to accommodate the deployment surge.

The Department of Defense (DOD) representatives observed that calls to U.S. ports by megaships may provide benefits to the military: these megaships will require expanded port capacity and will require capacity improvements to highways and rail lines. Port representatives at the regional meetings pointed to the vital role that they play in national defense as justification for DOD and other Federal assistance in improving transportation access to their facilities. Specifically, the ports saw the need for Federal investments in unobstructed rail access, such as making grade crossing improvements and eliminating conflicts between freight and passenger movements. Meeting participants noted that as more capacity is squeezed out of facilities such as ports, highways, and railroads, this infrastructure has more limited ability to respond to surges on demand such as those caused by seasonal peaks, natural disasters, or emergency responses.

Recent public/private partnerships in the maritime sector have allowed DOT to assist DOD in their contingency shipping needs. The Voluntary Intermodal Shipping Agreement (VISA) is the mechanism under which carriers provide origin-to-destination transportation during military contingency. The companies in VISA offer their sophisticated systems of in-transit visibility and worldwide intermodal networks for DOD use. In addition, the Maritime Security Program (MSP) provide an active privately owned U.S.-flag and U.S.-crewed merchant fleet for sealift sustainment use. This 10 year program expands the sphere of participation to a wide spectrum of companies that operate in worldwide trades. This diverse mix of ships and services gives DOD the ability to fill gaps in surge capability.

Railroad Perspective

Many people at the regional meetings stated that the recent round of rail consolidations and mergers will allow routing efficiencies for carriers and shippers, and as railroads consolidate, it may lead to new hubs for megaships. If a few truly transcontinental railroads will result from these consolidations and mergers, the coastal terminals would become likely candidates for megaship calls or feeder port status. Attention should not be exclusively on direct access by transcontinental railroads, since there will still be the need to have short haul trains to the feeder ports that will serve hub ports.

The recent round of mergers has involved considerable expense for the railroads. Some participants at the meetings questioned whether the railroads are likely to have funds available in the near term to make large scale investments to accommodate port calls by megaships. Other participants argued that the opposite was true—the railroads have to grow their traffic to pay their bills. Under the latter scenario, the railroads will have to be more aggressive about seeking business, including any increased intermodal traffic that might be generated by the arrival of megaships. The intermodal freight sector is an aggressive and growing market for railroads today.

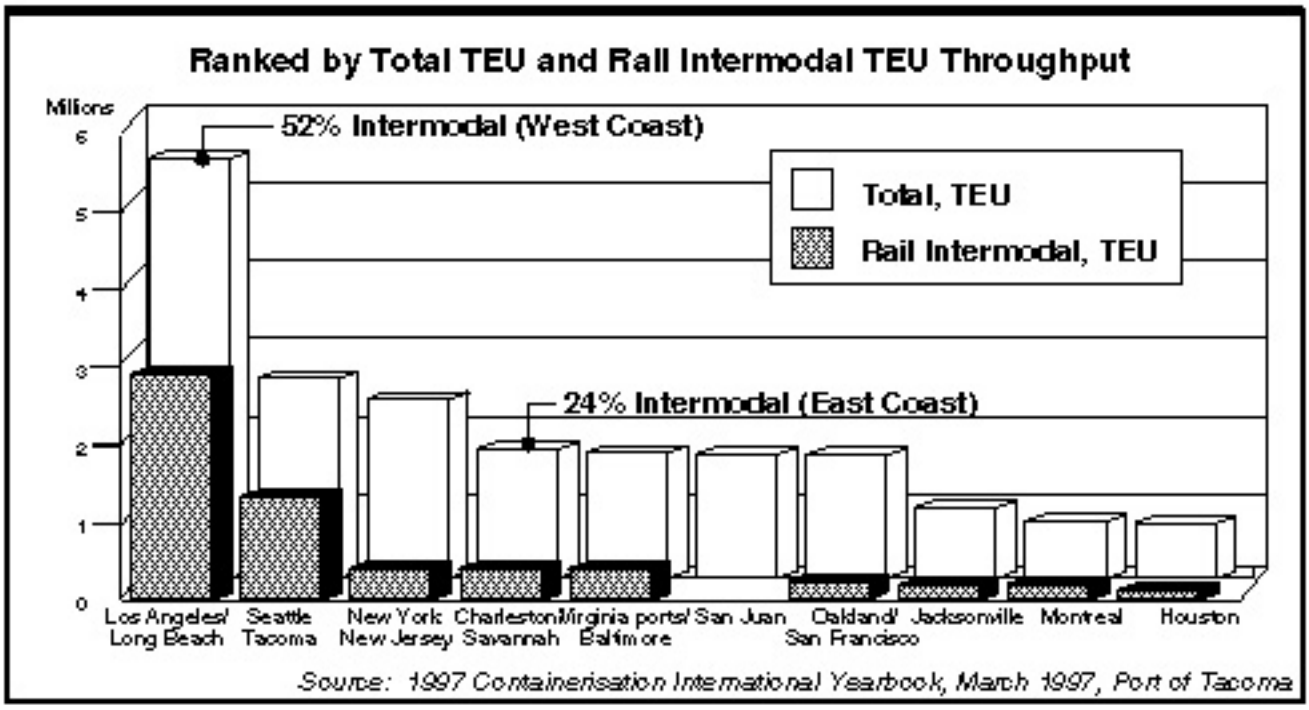
Border issues and international competition for freight transport will become more complex as railroads become more consolidated. For example, port industry representatives pointed out that the Canadian National and Canadian Pacific Railroads invest in ondock rail, and this type of thinking doesn't come from U.S. rail concerns. The rail industry has estimated that as many as 350,000 containers a year destined for Montreal and Halifax could be diverted to U.S. carriers. Port representatives characterized the U.S. railroad industry's perspective as "deliver freight to the rail terminal or build the rail connections from the dock and then call us." In terms of overall business, the railroads make more money hauling coal and grain, and make comparatively less from intermodal moves off the dock. Attendees noted that the BNSF Railroad has always been aggressive and future-oriented in developing intermodal service, and their investments and operating practices will have a big impact elsewhere in the industry.

Railroads were characterized as having an obvious interest in terminal issues and how megaship calls will affect their terminals. Increases in intermodal rail freight lead to longer and more frequent trains on rail lines, and communities along these lines are objecting to the increased train traffic through their neighborhoods. While Federal rail transportation policies need to address community quality of life concerns and mitigating negative impacts of train operations, railroad representatives said that these policies must also address donor and donee questions. Railroads pay 5.55 cents per gallon of diesel fuel and would like their taxes spent on rail investments rather than go towards deficit reduction as part of the General Fund.

Corps of Engineers Perspective

The Corps of Engineers (Corps) is part of the United States Army and has a major role in water resources

1997 Top North American Container Gateways



policy by sharing responsibility with ports for constructing and maintaining channels, jetties, turning basins and other general navigation features. Congress grants the Corps authority for maritime and navigation channel improvements through water resource development acts. The Corps doesn't initiate projects independently, but responds to the directive of the Administration and Congress responding to the requests of States and local communities. In addition to commercial navigation, the other priority water resources missions of the Corps are flood damage reduction and the restoration and protection of environmental resources.

The Corps evaluates water resources projects using the "Principles and Guidelines for Water and Related Land Resources Implementation Studies" which were established by Executive Order in March 1983. The Principles and Guidelines provide a consistent analytic framework for evaluating the economic efficiency of alternative plans for water resource development. Plans are compared on the basis of "willingness-to-pay", which reflects the market realities of our economy. Under the Principles and Guidelines, plans for navigation improvement are recommended for implementation if they reasonably maximize net national economic development benefits and are consistent with protecting the Nation's environment.

Funds for navigation projects are appropriated through Energy and Water Development Appropriations Acts. The Corps attempts to balance several high priority interests and objectives in its budget recommendation: investment in water resource infrastructure development is balanced with investment in watershed and other environmental restoration, and maintenance/rehabilitation of existing projects is balanced with construction of new water resources development projects. Given the Corps' budget objectives and the realities of budgetary constraints, it will be a challenge to continue to operate and maintain the existing harbor infrastructure while meeting the needs for new navigation investment in channel deepening and widening necessitated by the new megaships.

The Corps, however, is committed to continue to make the navigation investments necessary to keep the United States competitive in world trade. This does not mean that every port must have the capability to accommodate fully loaded megaships. The Corps remains committed to working with the Administration and the Congress to meet navigation needs such as deepening and widening of navigation channels to accommodate megaships when these needs can be justified on the basis of national economic development benefits exceeding the costs and there is a willing and capable non-Federal partner.

Implications for USDOT Policies

Several participants at the regional meetings expressed their frustration at what they regarded as a lack of coherent, mutually supportive national policies that support the intermodal transportation infrastructure that is vital to the health of ports and to our Nation's economic competitiveness. These speakers observed that it is monumentally expensive to meet corridor transportation demands and there is neither the awareness nor the financial commitment to address them. At every meeting it was pointed out that our country is already impacted by new east/west trade corridors, and that the cities that are gateways to these corridors—and are traversed by them—don't have the resources to invest in the new infrastructure that is needed. Port industry representatives noted that the U.S. Treasury receives $150 billion annually in tax revenues from goods handled by U.S. ports, and continued investment in our ports is essential to ensure that they remain competitive in the global economy and act as a vital component of our national security infrastructure. Under-investment in these facilities, and the transportation infrastructure that serves them, was seen as a national problem that will take national money to correct.

Questions relating to the private sector share of project investment and impact mitigation were frequently raised at the outreach meetings. Many of the people present thought that those parties who profit directly from freight movements ought to pay for mitigating the negative impacts of those movements. For example, parties responsible for generating and carrying the freight handled by ports should pay for mitigating the adverse impacts of that freight as it is transported through other regions and States. The private sector share of the money to offset these negative impacts would come from the steamship lines, commercial motor carriers, and the railroads. Even in instances where federal funds will not constitute a major portion of project financing, many participants believed that federal funds and federal participation would be essential in forming project partnerships by being the magnet that could draw the parties and funding sources together.

An interesting analogy was raised concerning differences in the approach of transportation equipment manufacturers and carriers to public authorities on aviation issues versus the approach to public authorities on port issues. The aircraft manufacturers were willing to talk to the airport community to ensure that their new generations of planes could land at as many airports as possible. The aircraft manufacturers also went to the airlines to determine their respective needs for equipment fleets and service routes. The Federal Aviation Administration subsequently used cost/benefit analyses to determine the priorities for airport infrastructure investments under the Airport Improvement Program. Participants asked that if vessel manufacturers and steamship lines are demanding that the ports and public as well as private transportation providers make major infrastructure improvements, wouldn't there be a way for the Federal Government to consider similar investments for ports and access for those ports? During the meetings it was noted that there is much more cooperation between airport planners, plane manufacturers, airlines and airports than there is in the maritime industry.

Some attendees at the meetings called for the Federal Government—through the Departments of Transportation and Defense—to take an active role in the decision making process that determines the locations of U.S. hub ports that will serve megaships. Government commitments will be particularly effective in influencing the port terminal investments and contracts made by big steamship lines. Those attendees contended that if the Federal Government doesn't take affirmative steps, and megaships ports are located in other countries or offshore, then the United States will become both economically and militarily disadvantaged. Other participants offered an opposing point of view—that the Federal Government should not attempt to select ports for development as megaship hubs—and these decisions should be left, instead, to the marketplace.

Many of the representatives from the maritime and international trade industry also questioned how they could be expected to address issues in a coordinated fashion when there hasn't been an effective integration of programs and funding sources within USDOT and other agencies. In the view of many meeting participants, if the Federal Government is serious about preserving the Nation's competitive edge in trade and an adequate platform for military deployment, then Federal agencies such as USDOT and DOD will have to make decisions on how transportation investments are going to be made to accomplish these objectives. Participants believed that a lack of coordination between users and customers in the maritime industry is compounded by uncoordinated Federal programs and the lack of funds for systemic transportation improvements, such as port-related freight movements. These problems result from an absence of centrality in Federal policy, and separate funding sources that are overly restrictive in project eligibility.

The feedback from the regional meetings clearly called for Federal agencies to provide a planning framework for economic analysis that could assess implications of larger scale, corridor-based transportation improvements. By using a framework based on cost/benefit analysis, agencies could make sure investments are not frustrated at some distant point by guaranteeing a funding stream for projects that were shown to be meritorious. These analyses would consider transportation investments based on project significance in terms of domestic and international traffic. Another criterion would be the partnerships that the corridor users created to match public and private funding for transportation improvements. Loan guarantees could be earmarked to ensure that when local money was committed to the project, Federal money would be there.

Port and other transportation industry participants recognized the dilemma in not wanting port rationalization or national transportation planning, but wanting the Federal Government to set priorities for major transportation investments. Those at the meetings acknowledged that such Federal oversight had been required in the past for programs such as the Interstate Highway System, aviation, and ports and waterways, but were concerned nonetheless about the consequences of a process that might not see merit for their own programs or operations due to an inability of the Federal Government to adequately assess local factors. Transportation professionals at the State and local levels and in the private sector agonize over the development of cost/benefit ratios that would scale their requests on the basis of being in the national interest. Meeting participants asked if, in addition to providing money for large scale capital improvements, the Federal Government could create incentives to reward public and quasi-public entities for becoming more transportation efficient.

At all of the regional meetings, those in attendance recognized that there are difficulties in determining which projects the Federal Government should participate in, what levels of Federal investment should be made, which issues should be considered when we coordinate and allocate our limited resources, and how the Federal Government's program can be consolidated to provide more meaningful investments. In laying out a rational process for making investments, these participants pointed out that the political process represents an unpredictable element. Those who would rely on a ranking process would have to assume that logic will carry the day when making their case. While those commenting noted that making a sound case for infrastructure investment was essential, this action alone would not guarantee success because there are local, State, and national political processes involved—each with their own sets of unique and sometimes conflicting priorities. Concerted action would have to be taken on both analytical and political processes if sound, quantitatively-based frameworks for project investment are to be approved.

Some of the meeting participants called for Federal policies that would allow more flexible use of revenues derived from the Harbor Maintenance Tax. These participants were aware of the uncertain status of the Harbor Maintenance Tax following a June 3 decision by the Federal Circuit Court that found the tax to be unconstitutional when levied on export cargo. But those at the meetings also pointed out that the amount of revenues collected by the Harbor Maintenance Tax and deposited in the Harbor Maintenance Trust Fund exceeded the expenditures from the Trust Fund for maintenance purposes. The Trust Fund was projected to have a surplus exceeding $800 million at the end of Fiscal Year 1996, and attendees questioned why these revenues couldn't be spent on infrastructure improve-

ments. Regardless of the funding mechanism that is used, industry representatives called for the U.S. DOT to provide a more logical user-based fee to eliminate the disparity between donors and donees and greater flexibility to finance other improvements necessitated by growth.

Those attending the meetings also urged that additional sources of revenue, such as Customs revenues, be made available for making infrastructure improvements. Regardless of the funding mechanism that is used, industry representatives called for the U.S. DOT to provide a more logical user-based fee to eliminate the disparity between donors and donees and greater flexibility to finance other improvements necessitated by growth.

Those attending the meetings also urged that additional sources of revenue, such as Customs revenues, be made available for making infrastructure improvements. If transportation infrastructure is required to handle the international trade products entering the United States, participants questioned why portions of these trade revenues could not be used for infrastructure improvements, including inland connections and corridors that can be directly linked to international port traffic. These people advocated that more of the fees and duties collected at the ports ought to be returned to the ports that collect them.

Summation

In this era of dynamic developments in transportation, USDOT is reviewing its responsibilities to its constituents in the formalization of policy decisionmaking, coordination of interstate activities and funding. In the course of the four regional meetings held around the country, many participants urged the Federal Government to assume the roles of primary analyst, advocate, and partner on issues involving major transportation investments occasioned by megaships calling on U.S. ports and other next generation vessels, such as FastShip Atlantic, now in the planning stages. The USDOT was encouraged to develop analytical frameworks and processes for prioritizing transportation investments of regional and national significance, and to provide mechanisms through which these investments could be made. Federal agencies were asked to embrace mutually supportive policies that are more sensitive to the demands of the marketplace and pursue approval processes that are based on project merits and are comparatively free of political intervention.

The regional meetings on projected increases in international freight movements produced the following general conclusions:

- There are numerous infrastructure, regulatory, institutional, operational, and technological issues and opportunities that may impact U.S. ports and the inland intermodal transport system as a result of significant changes in ship design and operation.
- The development of a safe and efficient international intermodal trade transport system will require a coordinated set of actions involving a wide range of parties and institutions, both public and private.
- In the absence of a central authority tasked with overall responsibility to address the challenges of increased intermodal movements of international freight, the achievement of a coordinated set of actions would benefit from continuous attention to these issues, rather than the periodic and disjointed reviews and appraisals.

Meeting participants suggested that the Federal Government could come to the table with a portfolio to look for common solutions and bring all of the parties together who would have an interest in the project and would be asked to make a financial commitment. Where there are common interests on transportation issues, the USDOT was asked to take the lead and get involved with its constituents and other Federal agencies. Several participants cautioned, however, that any partnership of government with business requires that the private sector stay committed to the cause, and that this was a hard commitment to secure.

Those attending the regional meetings noted that the Federal Government also could play an important role by providing consistent information about what is going on elsewhere in the country. Participants observed that good information simply isn't passed on to them about what planning and investment strategies being employed in other regions or States. This clearinghouse function would entail several components, including information on transportation statistics, policy statements, rulemaking activities, best practices, and educational opportunities.

The dynamics of a customer-driven marketplace with developments such as megaship service, faster shelf-to-shelf movement and superior service create ever-increasing demands for our transportation system. The common question faced by ocean carriers, shippers, port and rail operators, truckers, and transportation agency representatives is how to provide transportation service to address these needs and meet the challenges that lie ahead. Complex issues are involved and there is no single solution that can be applied. Many of the problems that need to be resolved will require congressional action. Many will require action by several Federal agencies. There are only a limited number of issues that can be addressed solely from the perspective of the U.S. Department of Transportation.

Part of the problem lies in the proliferation of regulations and multi-agency oversight. There are very disjointed processes at Federal, State and local levels, and among public and private sector groups. Stakeholders in freight transportation need to find ways to cooperate better out of self-interest. The meeting participants called for the Federal Government to assist in the planning process by creating mechanisms to bring freight issues to the table. A venue is needed for ongoing dialogue that will get the private sector involved in freight policy development. Federal agencies must address the performance expectations of military and commercial customers through outreach, education, technical assistance, and collaboration.

Next Steps

To address the complex issues raised by the introduction of larger ships and more international freight into the transportation system, the USDOT will undertake two new initiatives. One of these "next steps" will involve a Waterways Transportation Management initiative led by the U.S. Coast Guard and the Maritime Administration. The second initiative will be a comprehensive study by the Federal Highway Administration (FHWA), with assistance from other USDOT operating administrations, that will address National Highway System Intermodal Connectors Performance and Needs Evaluation.

Under the USDOT Waterways Transportation Management initiative, the U.S. Coast Guard and the Maritime Administration will work to improve an integral component of our national transportation system—the safety and efficiency of our ports and waterways. Waterways Transportation Management will focus on policy coordination at the national level and action at the local port level. Adequate infrastructure, including channel and berth depths, navigation information, port facilities, intermodal connections and information management to accommodate all classes of marine vessels—including large container vessels—are among the waterways issues encompassed within this initiative. The Waterways Transportation Management initiative will begin with a series of regional outreach meetings in the Spring of 1998 to solicit input from transportation stakeholders.

The National Highway System (NHS) Intermodal Connectors Performance and Needs Evaluation Study will compile information on the NHS connections to major passenger and freight intermodal terminals that were identified by the FHWA in cooperation with the States and submitted to Congress for approval in May 1996. These connections totaled 2032 miles and served 1407 terminals, of which 500 were freight terminals. Because very limited information exists on the conditions and performance of these NHS intermodal connectors, the FHWA is proposing a study—with assistance from other USDOT operating administrations–that will:

1) Evaluate highway infrastructure condition of National Highway System (NHS) connections to major intermodal terminals.
2) Identify improvements that have been made or are being planned for intermodal connections and identify impediments to making improvements to them.
3) Identify other non-highway infrastructure, regulatory, institutional and operational impediments to intermodal terminal access.

The drafting of a work plan for the NHS Intermodal Connectors Performance and Needs Evaluation Study began in January 1998, and a report on the study findings is planned for the summer of 1999.

These next steps will address the infrastructure, regulatory, and institutional issues raised by the dramatic increases projected for international freight from both a landside and waterside transportation perspective, and build upon the information gained through the recent round of megaships outreach meetings. The Department of Transportation believes that these actions represent a reasonable and timely response that is in keeping with the wishes of its constituents and its responsibilities as a steward of our nation's transportation system.

Appendix A Background Information

This technical appendix presents background information on the introduction of megaships and their consequences for market and industry trends, projected impacts on infrastructure, and projected impacts on transportation operations. This resource material was prepared for the participants at the four regional meetings by USDOT's principal consultant for the megaship study, Vickerman-Zachery-Miller (VZM), a division of TranSystems Corporation. Mr. John Vickerman of VZM served as facilitator for the first day's discussions at each of the regional meetings, and relied upon this material in leading group discussions of these issues.

MARKET & INDUSTRY TRENDS OVERVIEW

Introduction

This background section provides an overview of trends relating to world and U.S. container trade with an emphasis on U.S. Atlantic, Pacific and Gulf Coast ports. It presents current information on the physical characteristics and projected utilization of next- generation containerships. Other significant trends are identified in the areas of terminal infrastructure, waterside access, landside access, terminal operations and shipping logistics.

Between 1991 and 1995, world container trade grew at an incredible rate of 9.5% per year, reaching more than 134 million twenty-foot equivalent container units (TEUs) in 1995. Growth in the U.S. trades has been somewhat lower, but still extremely rapid, at 6.0% per year to reach more than 21 million TEUs in 1995. Worldwide growth is forecast at a CAGR of 8.0% through the year 2000 and total U.S. growth is forecast at 7.8% through 2010.

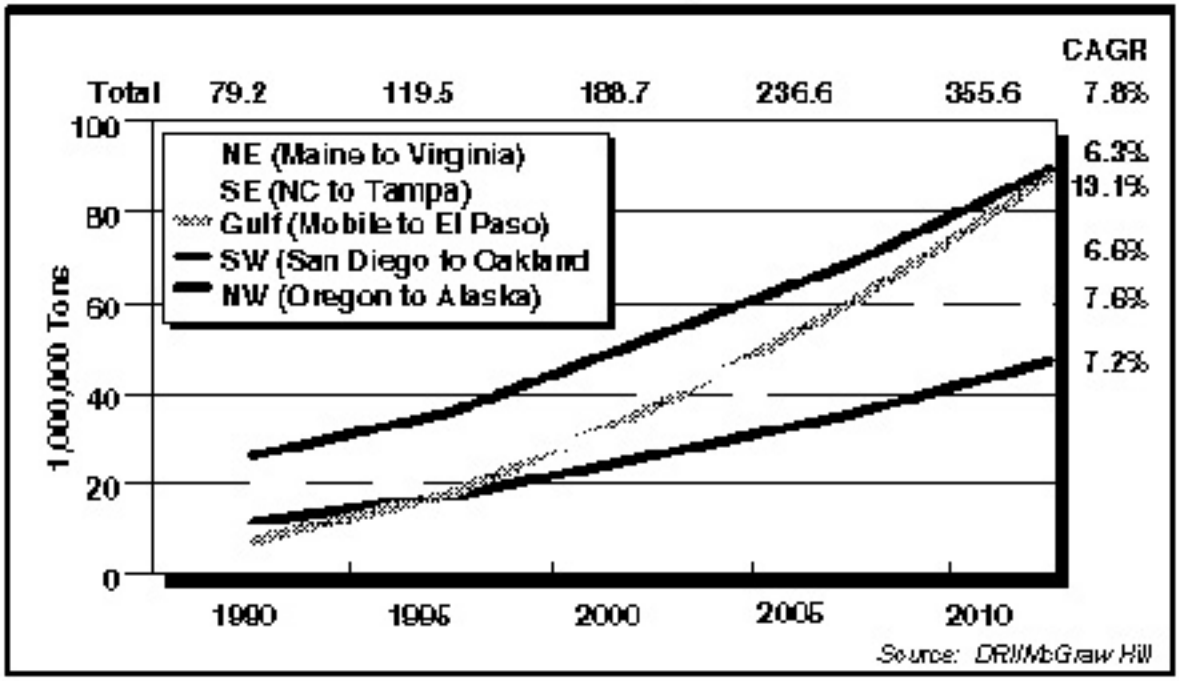
The leading world ports in 1995 were Hong Kong (12.5 million TEUs), Singapore (10.8 million TEUs) and Kaohsiung (5.2 million TEUs). Long Beach, CA, the leading U.S. port, ranked seventh. Among U.S. ports, the leaders in 1995 were Long Beach (2.8 million TEUs), Los Angeles, CA (2.6 million TEUs)

Canadia/U.S. Port Container Traffic (TEUs), 1996

1. Long Beach	3,067,334	11. Houston	794,481
2. Los Angeles	2,682,802	12. Port Everglades	701,281
3. New York/New Jersey	2,269,500	13. Miami	656,798
4. San Juan (PR)	1,640,624	14. Savannah	650,253
5. Oakland	1,498,202	15. Vancouver (BC)	616,892
6. Seattle	1,473,561	16. Jacksonville	613,448
7. Hampton Roads	1,141,357	17. Baltimore	474,816
8. Charleston	1,078,590	18. Honolulu	453,044
9. Tacoma	1,073,471	19. Halifax	392,273
10. Montreal	852,530	20. Anchorage	337,770

Source: AAPA, 1997

U.S. Containerized Tonnage Forecast



and New York/New Jersey (2.3 million TEUs). According to recent 1996 figures, Long Beach has climbed to 3.0 million TEUs and Los Angeles traffic has increased to nearly 2.7 million TEUs.

Atlantic Coast Ports

Looking at Atlantic ports, the 1996 leaders in terms of TEUs are New York/New Jersey (2,269,500), San Juan PR (1,640,624), Hampton Roads, VA (1,141,357), Charleston, SC (1,078,590), Montreal, Quebec (852,530), Port Everglades, FL (701,281) and Miami, FL (656,798). Between 1985 and 1996, Atlantic ports grew at a combined Compound Annual Growth Rate (CAGR) of approximately 4.6%, which is lower than the world rate and slightly lower than the overall U.S. rate of 6.0%. Some ports—particularly Hampton Roads, Charleston, Port Everglades, Miami and Jacksonville, FL—grew at or near double-digit rates in this period, while others experienced moderate growth or stable traffic. Forecasts by DRI/McGraw-Hill (DRI) suggest that the Atlantic ports are poised for more rapid growth, with Northeast ports (Maine to Virginia) projected at an aggregate 6.6% CAGR and Southeast ports (North Carolina to Florida) projected at an aggregate 7.6% CAGR.

Pacific Coast Ports

Looking at West Coast ports, the leaders behind Long Beach and Los Angeles (2.8 and 2.6 million TEUs, respectively) are Oakland, CA (1.5 million TEUs), Seattle, WA (1.5 million TEUs), Tacoma, WA (1.1 million TEUs), Honolulu, HA (0.8 million TEUs) and Vancouver, BC (0.5 million TEUs). Total West Coast container trade reached 11.4 million TEUs in 1995. Between 1985 and 1995, West Coast ports grew at a combined CAGR of 7.9%, which is close to the world rate and significantly better than the overall U.S. rate of 6.0%. Most ports more than doubled their container volumes in this period, with the strongest growth in Long Beach, Los Angeles, Tacoma, Vancouver, BC and Portland, OR. Future volumes through the Northwest ports (Oregon to Alaska) are forecast at a CAGR of 7.2%, while Southwest ports (Oakland to San Diego) volumes are forecast at a CAGR of 6.3%.

Gulf Coast Ports

Looking at Gulf Coast ports, the 1996 leaders in terms of TEUs are Houston, TX (794,000), Veracruz, Mexico (265,000), New Orleans, LA (261,000), Gulfport, MS (153,000), Freeport, Bahamas (48,000), Lake Charles, LA (34,000) and Fernandina (32,000). Between 1985 and 1995, Gulf Coast ports grew at a combined CAGR of approximately 3.3%, which is lower than the world rate and the overall U.S. rate of 6.0%. Some ports—particularly Houston and Gulfport—experienced strong growth in this period, while others remained stable or lost container traffic. Forecasts suggest that the Gulf is poised for a major upturn in container traffic due to containerization of bulk cargo, increased trade with Mexico, Latin America and South America, and other factors, with growth rates possibly reaching as high as 13.1% annually.

NEXT-GENERATION VESSELS AND MARKET PENETRATION

To move these increasing volumes, some shipping companies have ordered larger, faster vessels. One advantage is that with increasing size and speed, the transport cost per TEU slot is reduced—provided that these slots are filled with revenue cargo. As of November 1996, the large majority of vessels in the world container fleet were in the "Feeder" class (less than 1000 TEUs). The 36 megaships (vessels in excess of 4,500 TEUs) in service accounted for only 1% of the total fleet by number. However, 45 megaships are currently on order, representing 8% of the order book and about 18% of the new capacity on order.

Recent and planned deployments through 1997 include six ships by the shipping line COSCO, 5 by Hanjin and 5 by Hyundai, all in excess of 5,000 TEUs. The largest is the "Regina Maersk" class at 6,000 TEUs. These vessels will be deployed in the Far East/Pacific and Far East/European trades. In addition to the planned 1997 deployments, there are another 28 megaship orders, including P+O/Nedlloyd's order for six containerships with capacities of 6,674 TEUs—the largest in the world.

Impacts of Larger Vessels

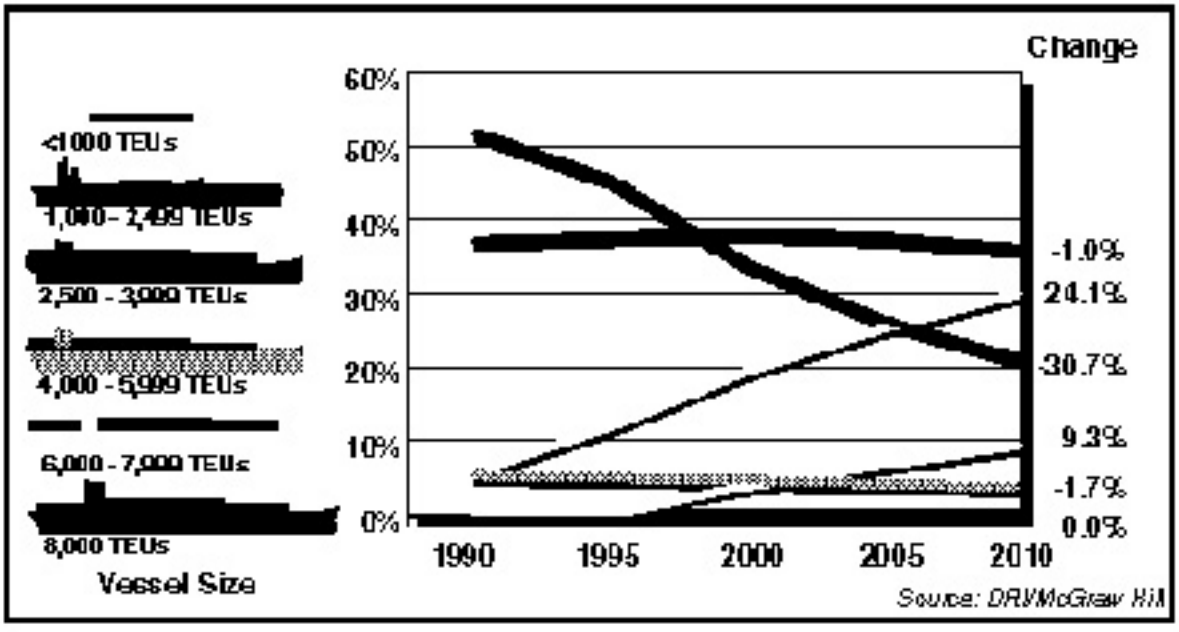
In 1990, less than 6% of U.S. containerized cargo was handled on ships of 4,000 TEUs or more. By 2010, almost 30% is projected to be handled on ships in the 4,000 to 6,000 TEU class, with more than 9% in the 6,000 to 8,000 TEU class. It must be emphasized that these are maximum figures assuming "unconstrained" conditions—that is, they assume that (a) the infrastructure would be available to handle these vessels, and (b) that carriers would find it profitable to deploy them on U.S. itineraries. To the extent that these assumptions are not proven out, the share of cargo handled by megaships would be less.

Ports that can accommodate megaships are in a position to capture this market. However, "smaller" ships in the Panamax (2,500 to 3,999 TEU) class are forecast to maintain their current share (36%) of cargo. In 1990, these ships moved more than 29 million TEUs to and from U.S. ports; just by maintaining share, their total tonnage will more than quadruple to 128 million TEUs in 2010, making them the most heavily-used class of ship in U.S. services. This is critically important, because it suggests that ports that can accommodate these ships (but not megaships) will continue to play a major role in future U.S. shipping, and that there are major consequences for transportation throughput facing the majority of U.S. ports that will not be called upon by megaships.

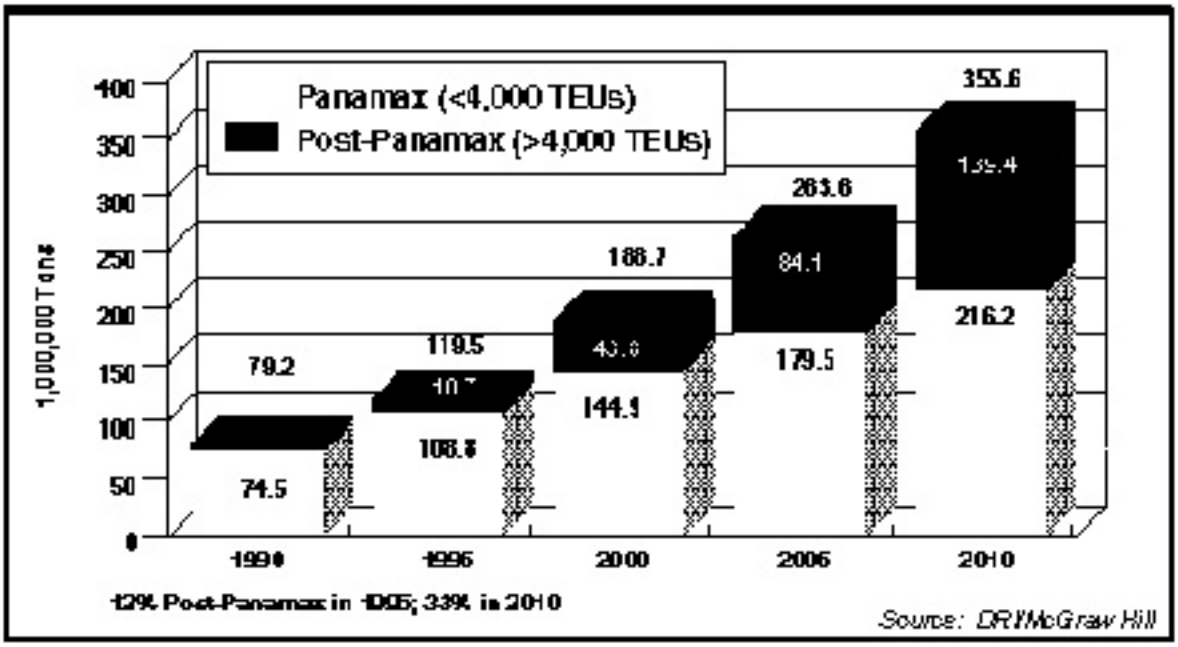
Containership Size Limits

The physical and operational characteristics of ships change as their capacity increases, placing increasing demands on navigation channels, port infrastructure and landside access capabilities. "Panamax" vessels (the largest that can transit the Panama Canal) average 896 feet in length and not more than 106 feet across the beam, with a draft just over 39 feet. The largest "Post-Panamax" ships in the fleet today average around 925 feet in length and 125 feet across the beam, with a draft of over 43 feet. Looking at four of

Forecast Share of U.S. Containerized Tonnage by Vessel Type



U.S. Containerized Tonnage Forecast—Panamax vs. Post-Panamax Vessels



the newest megaships—the Regina Maersk, Hanjin London, Hyundai Independence and APL C-11 class—the maximum length (1049 feet) and beam (140 feet) belong to the Regina Maersk, while the maximum drafts (46 feet) are shared by the other three vessels. HDW in Europe has proposed a 8,000 TEU ship that is 1,099 feet in length.

Much larger vessels are technically feasible. However, between 7,000 and 8,000 TEUs, it will become increasingly difficult for containerships to make required speed (24 knots or more) using today's single-engine propulsion systems. This barrier may be overcome through advances in propulsion systems and hull design, or by adding a second propulsion shaft. With a second shaft, vessel cost can jump dramatically but the cost per TEU slot can be minimized by making the ship as large as the new propulsion capacity allows. In fact, P+O Containers has raised the idea that the largest single-propulsion vessel (say 7,500 TEUs) could be doubled in capacity to 15,000 TEUs by adding a second propulsion shaft; they opine that "the ship is a flight of fancy ... but such a ship is within the current state of the shipbuilder's art."

Other factors may be more significant in setting a maximum containership size. First, is there a deployment scenario that would allow a shipping company to keep the ship full enough and in motion often enough to pay for itself? Second, can you find water sufficiently deep to meet vessel deployment requirements? Third, can you find a terminal to handle it? Fourth, can you afford extensive transshipment and landside rail and truck transportation to serve markets outside your ports of call? With increasing vessel size, the deployment options and potential ports of call become sharply limited, and at some point it becomes uneconomic for ports, the U.S. Army Corps of Engineers and others in the freight movement chain to improve their access and infrastructure to service these vessels.

It may be hard to imagine much use for a ship larger than 8,000 TEUs or drafting more than 46 feet, due to the limited itineraries these ships would have and the channel depth constraints that would have to be overcome. But history is clearly against such limit-setting. Ten years ago, few imagined a 6,600 TEU vessel, and today it is under construction. It is possible that certain high-traffic corridors (e.g., Hong Kong to Long Beach/Los Angeles or Seattle/Tacoma) might see vessels larger than 8,000 TEUs in pendulum services or hub-and-spoke strategies.

Other Vessel Technologies

Besides megaships, there is another important trend in containership development—very fast container ships, such as FastShip Atlantic and Japan's TechnoSuperLiner. The next few years will be important in determining the penetration of these technologies and services into the marketplace.

Fleet Capacity

Finally, the extent of new shipbuilding raises the question of potential overcapacity. There are about 4.8 million TEU slots in the existing fleet. With 1.1 million TEU slots in vessels (of all sizes) on order, the capacity of the world fleet will soon be increased by 22%. Will the market be able to absorb this new slot capacity?

PROJECTED IMPACTS ON INFRASTRUCTURE

This background section provides an assessment of infrastructure impacts and requirements associated with next-generation container ships. Areas of examination include navigation channels, terminal design and equipment, landside access, port capabilities and planned improvements.

Navigation Channels

Panamax vessels typically draft 38 feet. Allowing 2 feet for vertical ship movement and 2 feet for under-keel clearance, these ships require a 42-foot channel. With Post-Panamax vessels, draft increases to around 42 feet (fully loaded) and a 46-foot channel is required. With megaships, maximum fully weight-loaded draft is estimated at 46 feet, requiring a 50-foot channel.

Ports that can provide channel depths approaching 50 feet or more are clearly advantaged, as they can handle heavily-loaded megaships as the sole U.S. port of call, or as the first in/last out call on a multi-port service. For certain services (involving shallower-draft or less than fully-loaded vessels), a 45-foot draft may be adequate.

It appears that drafts less than 45 feet will not be sufficient to handle megaship services. Even so, shallower-draft Atlantic ports should do well over the next two decades because: (1) smaller vessels are projected to handle the majority of tonnage through 2010; (2) light-loaded megaships can call at these ports on second in/out services; and (3) overall demand for container capacity in the Atlantic is expected to nearly triple by 2010, with the largest share of cargo in the Panamax vessel class (which can be accommodated at shallower drafts).

Atlantic Coast Ports

Looking at current permitted navigation channel depths at Atlantic container ports, three—Halifax, NS, Baltimore, MD and Hampton Roads—provide navigation channels at or below 50 feet. However, the deepest berths at these ports are 47 feet at Halifax, 45 feet at Hampton Roads and 42 feet at Baltimore. Several Atlantic ports (including New York, Charleston and Savannah, GA) are planning to deepen their channels and berths.

Pacific Coast Ports

The West Coast has four ports at 50 feet or deeper: Seattle, Tacoma, and Vancouver, BC, in the north and Long Beach in the south. To reach 50 feet, main channel improvements would be needed in Los Angeles (5 feet), Oakland (8 feet) and Portland (10 feet) to handle fully-loaded megaships. The need for improvements to turning basins to handle longer ships could also be triggered. Los Angeles has a project underway to deepen to 50 feet. Oakland is also talking about the need for 50 feet. However, prior dredging in the Bay area has been difficult due to environmental and permitting issues.

Gulf Coast Ports

No container port on the Gulf Coast provides 50 feet. The Houston Ship Channel is currently at 40 feet, with approval to deepen to 45 feet. New Orleans has a 45 foot main channel with 35 feet at its container berths, and has no plans to deepen. Gulfport provides 36 feet and has no plans to deepen.

TERMINAL DESIGN AND EQUIPMENT

Terminal design and equipment are substantially impacted by the deployment of megaships, particularly with respect to wharf crane and container storage requirements and the degree of transhipment that occurs at the facility.

Wharf Cranes

As container ships have become larger and wider, wharf cranes have evolved to serve these vessels. Panamax cranes (less than 144 feet outreach) serve Panamax vessels (106 ft. beam, with up to 13 container rows across the beam). Post-Panamax cranes (144-158 feet outreach) serve vessels between 13 and 16 containers wide.

The first megaships were designed with 40.0 meter beams (about 16 containers wide) and could be handled by the largest Post-Panamax cranes. However, the emergence of wider megaship designs forced the development of the Beyond Post-Panamax (BPP) crane (greater than 158 feet outreach) to handle 17-wide and 18-wide ships.

In 1995, Panamax cranes dominated with world crane population (77%), while BPP cranes accounted for just 3%. This is changing rapidly—looking at deliveries from 1996 through 1998, BPP cranes represent 44%, with Panamax at 30% and Post-Panamax at 23%. This trend is even more pronounced in North America; with BPP cranes representing 55 of 66 deliveries (83%).

How many BPP cranes will it take to unload a megaship? This depends on a number of variables including the size of the vessel, percent of vessel cargo to be offloaded/loaded, productivity of the cranes and the amount of time the vessel can remain at berth. In normal services, a ship makes several calls and

World Crane Population—Existing and On Order

Size	Ship Handling	Operating in 1995	1996 - 1998 Deliveries*	U.S./Canadian Orders 1996 - 1998
Panamax (<144' outreach)	13 wide 32.2m beam <4000 TEU	77%	30%	7
Post Panamax (144' - 156' outreach)	16 wide 40.0m beam 4000-6000 TEUS	19%	23%	4
Beyond-Post Panamax (>156' outreach)	17 wide + 42.5m + beam 6000 TEU +	3%	44%	55
* A total investment of $12 billion dollars.				
Source: Containerisation International, AAPA and P&O Containers				

offloads/onloads a relatively low percentage of its cargo at each port. With larger ships, fewer calls would be made and a larger percentage of cargo would be offloaded/onloaded at each port. A single-call service to a major hub might involve offloading and onloading 85% of vessel capacity (with 15% assumed as a typical factor for empty slots).

If a 5,000 TEU vessel makes one U.S. call, 8,500 TEUs would be handled (using an 85% load factor). With an assumed BPP crane productivity of 25 lifts per hour (45 TEUs), a total of 189 crane- hours would be needed. With four cranes working the ship, time working at berth would be 47 hours, which is longer than most current container ship calls. Adding cranes reduces working time (38 hours with five cranes and 32 hours with six cranes), but these times are still longer than current one-day turnarounds. These figures would be reduced, of course, if the vessel made two or more North American calls and loaded/unloaded a smaller percent of its capacity at each.

Container Storage Requirements

How much container storage is needed to serve each vessel berth? Historically, the ratio of container storage to berths has increased as vessel size has increased. This is due to the disconnect between wharf activity (rapid, around-the-clock transfer when vessels are at berth) and gate activity (more regular, 8-hour-a-day vehicle movements). Terminal storage serves as an intermediary between these two flows, with "dwell time" (the amount of time a box spends stored in the terminal) as the key variable. As larger vessels are unloaded more rapidly and the disconnect between land and water flow rates becomes greater, larger terminal storage areas become necessary.

Operationally, there are a number of things a terminal can do to reduce the amount of storage required (denser stacking, longer operating hours, use of ITS technologies, on-dock rail, etc.). If, however, it is assumed that terminals continue to operate more or less as they do presently, then container storage requirements per vessel berth would increase as a function of vessel size. The generally accepted ratio for state-of-the-art terminals for Post- Panamax vessels is 50 acres per berth. With design vessel sizes increasing by nearly 50%, it may be appropriate to increase the storage requirements by a similar factor, to 75 acres per berth. More research and simulation modeling will be needed to fine tune this number.

MEGASHIP TERMINAL DESIGN PARAMETERS

With this information, it is possible to begin to define parameters for an optimized megaship terminal. It could have the following physical characteristics:

—Minimum of 2,500 linear feet of berthing (two megaship berths @ 1,250 feet each).

—Up to 3,000 linear feet of berthing (three Post-Panamax berths @ 1,000 feet each) to accommodate a mix of vessels.

—50 foot water depths at berth.

—High berth occupancy rates (50% target). With two berths, there would be two ships 25% of the time, one ship 50% of the time, and no ships 25% of the time. Put another way, during times when vessels are at berth, 33% of the time there would be two at berth and 67% of the time there would be one at berth.

—A minimum of three Beyond Post-Panamax cranes per berth. This would result in three cranes per vessel 33% of the time and six cranes per vessel 67% of the time. The average service—five cranes per vessel—provides reasonable vessel turnaround times. However, more cranes per berth would certainly be desirable.

—Upgraded wharf load-bearing capacity for the BPP cranes.

—Up to 75 terminal acres per megaship berth or 50 acres per standard berth (150 acres for 2,500 to 3,000 linear feet of berthing).

—State-of-the-art gate complex and on-dock rail.

Such a terminal might reasonably provide a throughput of between 450,000 TEUs/year (3,000 per acre) and 900,000 TEUs/year (6,000 TEUs per acre), depending on operational factors such as storage density, working hours, use of advanced in-terminal equipment, intermodal rail utilization and degree of transshipment to/from the terminal.

New terminals on the U.S. West Coast are being designed to standards close to these. Existing terminals may need to be modified to conform to these criteria. At a minimum, they will need to meet the berth and crane standards; it is possible that operational improvements could substitute for increases in container storage area.

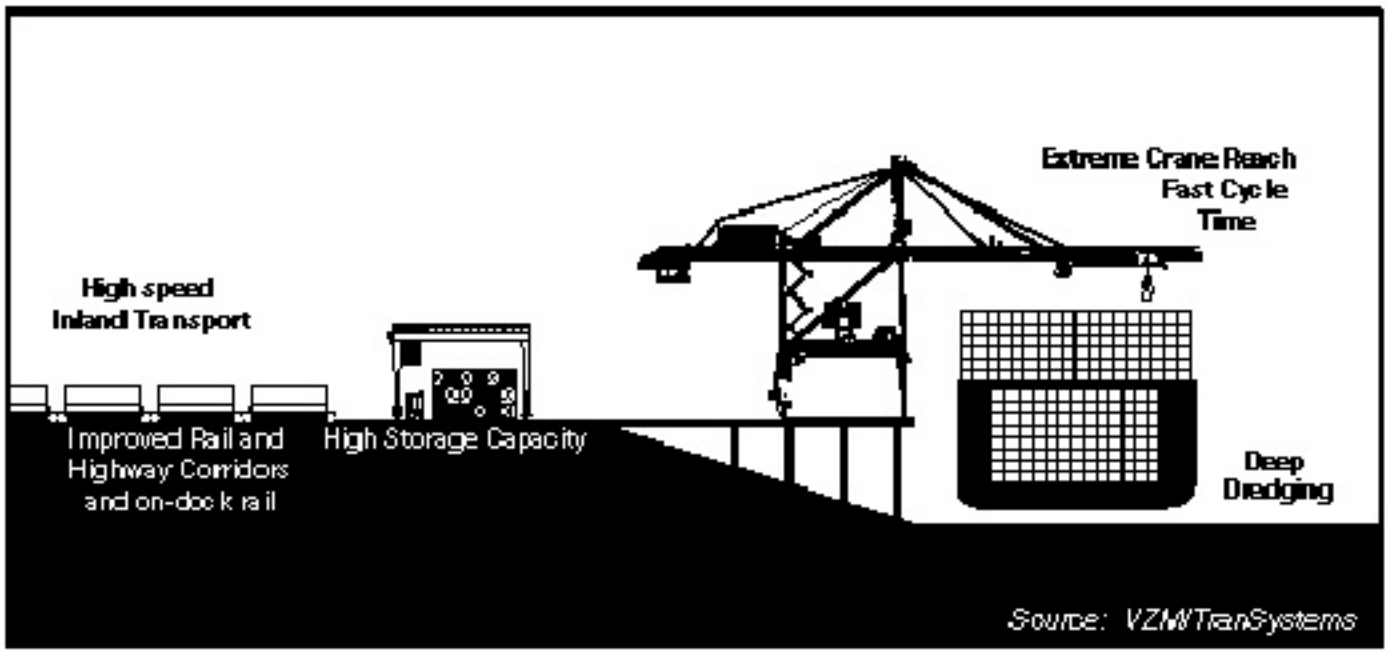
TRANSSHIPMENT TERMINALS

The terminal design parameters defined above assume an origin/destination port with very little ship-to-ship transfer. If ship-to-ship transfer is a large percentage of overall terminal throughput, the need for wharf and crane capacity is changed in direct proportion to the number of transshipped TEUs (which are counted on both inbound and outbound moves). Storage requirements change by half the number of transshipped TEUs (since there is one storage event for two wharf moves). Gate and landside access capacity is needed only for the non-transshipped TEUs. For example, let's assume a terminal with a throughput of 450,000 TEUs, of which half (225,000 TEUs) is transshipment. Looking at an idealized terminal module, two berths would still be required, but would need 25% less terminal acreage (from 150 acres down to 112 acres) and would only need gate and landside access capacity for 225,000 TEUs.

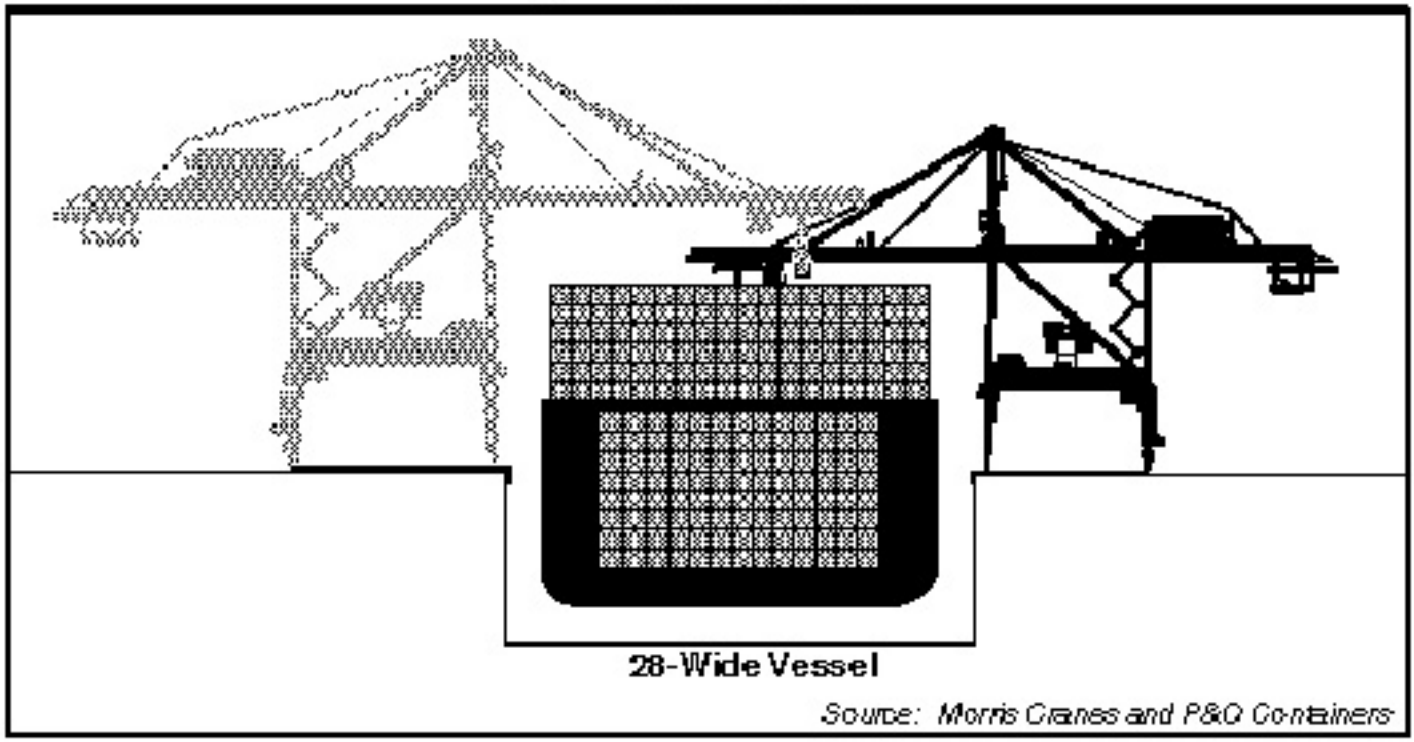
Alternatively, transshipment cargo could be handled at separate terminals specifically designed for that purpose. A 450,000 TEU/year transshipment terminal might have 2,500 linear feet of berthing (two megaship berths @1,250 feet each), an area of 75 acres and a very small gate. This terminal would be only 1,300 feet deep—about half the depth of a non-transshipment terminal.

Another way to handle transshipment is through "midstream" terminals. These are water areas in which a barge-mounted crane can be positioned between two vessels. The crane lifts the box off one vessel and onto another, possibly with an interim point of rest on the barge. The advantage of this operation is that it requires no land area; the disadvantages are that the barge-mounted cranes are slower than shoreside cranes, there is little room for interim storage/repositioning of boxes, and both vessels must be in the

Mega-Ships Require Specialized Ports With High Infrastructure Investment



Loading Strategy Using Finger Piers



Source: Morris Cranes and P&O Containers

same place at the same time. This is not theory—it is estimated that about 30% of Hong Kong's transshipment is handled this way, and New Orleans is also doing midstream transshipment.

A different design strategy for a transshipment terminal uses a finger pier with container cranes on each side and storage in the center. This allows vessels to berth on either side, and at different times or simultaneously. This strategy is currently being used in Singapore.

LANDSIDE ACCESS

The landside access systems serving U.S. ports have been evolving as rapidly as vessel design. In particular, the rapid rise of intermodal rail service has had a huge impact by facilitating the development of landbridge services. As much as 40% of West Coast international containers are handled by intermodal rail; this figure is lower elsewhere (generally between 10 and 25%) but appears to be rising. Three key trends are: the growing importance of intermodal rail; the continuing importance of truck access; and the degree to which effective landside access can "decouple" port locations from the metropolitan market areas they serve.

Intermodal Rail Impacts

As carriers concentrate at selected hub ports, more hinterland and coastal origins and destinations will fall outside of a 400-600 mile radius from the ports that serve them. Outside this radius, rail is cost-competitive with truck, so the result should be a substantial increase in intermodal rail activity. With increased use of intermodal rail, several effects are observed:

—Trips that otherwise would require trucks can be moved by rail, resulting in environmental benefits (fewer vehicle moves and lower emissions).

—Boxes that would otherwise remain in the terminal an average of seven days or more tend to leave the terminal in around two days, freeing up storage area for other boxes and reducing the total storage acres needed.

—Intermodal rail is a key attractor for shipping lines, particularly if service by competing carriers is available, the facilities are on-dock and the lines are cleared for double-stack trains. With ocean shippers and carriers becoming more integrated into the "total trip" chain, they will increasingly choose to consolidate at ports with superior intermodal connectivity.

The recent round of rail mergers (UP/SP, BN/SF and KCRC/TMM) and the proposed division of Conrail between NS and CSX is expected to result in an improved, rationalized U.S. railroad system. The mergers also pave the way for the formation of future transcontinental partnerships between remaining carriers, and for integrated long- term partnerships between rail companies, ocean carriers and port complexes.

Post-Panamax vessels and megaships can generate extremely high box traffic. The successful megaship terminal will need to provide on-dock or near-dock rail to serve these vessels and minimize the truck traffic and environmental impacts associated with huge, rapid transfers of cargo. There will be increasing demand on existing rail infrastructure and increasing need for projects like the Alameda Consolidated Transportation Corridor to rationalize rail access to ports. Other types of rail projects that may be needed for double-stack clearance and grade crossing elimination.

There also is significant concern about the inland impacts of rail traffic generated by ports. Midwest railyards and cross-country mainlines are rapidly approaching capacity. Additional port-related intermodal traffic may trigger the need for significant improvements hundreds or even thousands of miles inland from the ports themselves.

Truck Movements

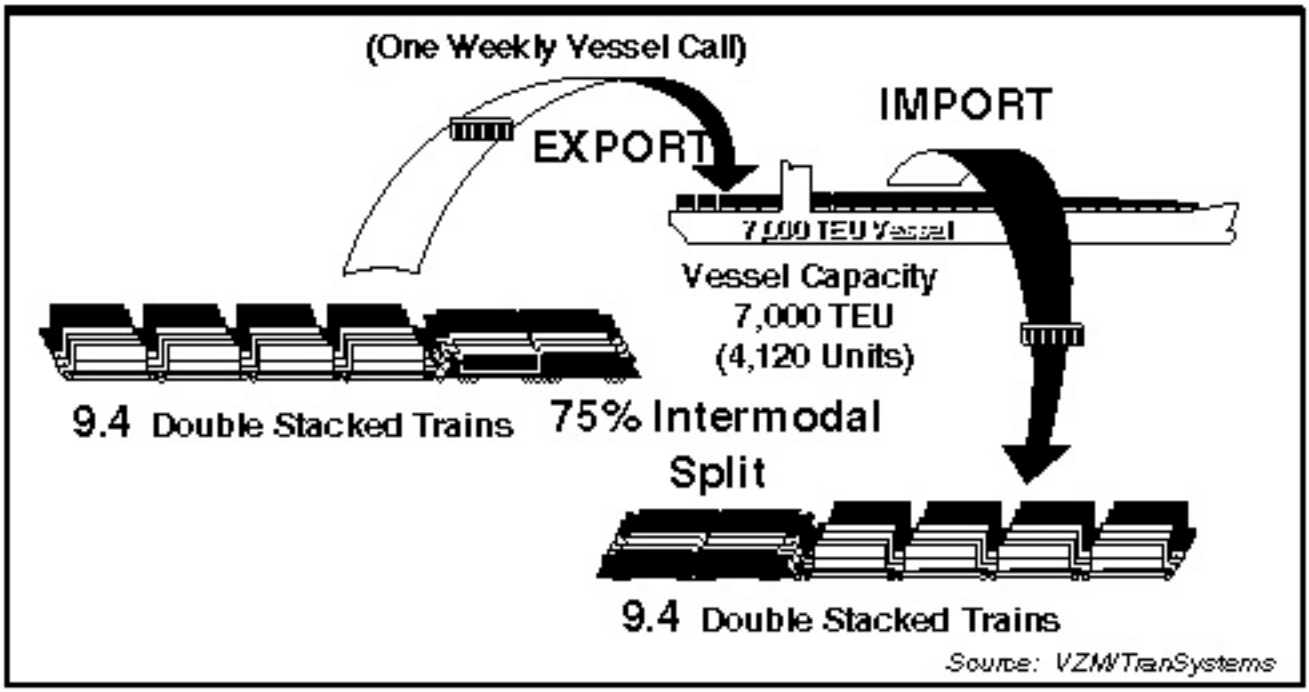
Trucks are expected to continue to carry the majority of port traffic, and the high trip generation from the megaship module illustrates that highway access will remain a critical concern. Providing safe roads, adequate travel lane and gate queuing capacity, and clear signage within ports will be critical concerns. There is also a growing understanding that freight movement is a statewide and even a multi-state issue. In fact, an ongoing study by thirteen southeastern States is looking at multi-state freight corridors to handle future port-related traffic from Latin American trade.

Truck volumes are extremely sensitive to the intermodal rail split. With throughput of between 450,000 and 900,000 TEUs per year through the gate (that is, excluding transshipment cargo) and a 40% share to on-dock rail, there might be anywhere from 1,730 to 3,460 truck trips on a typical day (assuming operation on weekdays); there might also be between 2 and 4 unit train calls per day (assuming operations through the week). With 0% to on-dock rail, there might be 2,880 to 5,770 truck trips on a typical day (5-day operation).

PORT CAPABILITIES AND PLANNED IMPROVEMENTS FOR MEGASHIP BERTHS

Historically, the water move was made up to a city dock. Now, with very expensive ships, the logistics objective shifts to minimizing vessel transit time and reducing the water move to the minimum possible. At the same time, deregulation of trucking and the rise of intermodal rail are making the landside move to "hinterland" destinations increasingly affordable. Over time, these two trends will reinforce each other. One likely effect is that ports located nearest to shipping lanes and providing superior landside access would grow fastest—with proximity to urban consumption

A 7,000 TEU Mega-Container Vessel Can Produce High Intermodal Rail Volumes



zones being of lesser importance—while ports at a distance from shipping lanes or suffering from poor landside access would see slower growth.

The future need for megaship berths in the US is difficult to measure. The DRI forecasts provide some guidance, but no conclusive answers. DRI has projected vessel calls on the basis of fully-loaded trips to and from a single U.S. port of call—an unlikely scenario in practice. Also, the vessel forecasts are "unconstrained" and assume both available capacity and a profitable market for megaship deployment. Still, working through the exercise using reasonable assumptions (25 lifts/hr, 5 cranes per berth, 33% berth occupancy, around-the-clock berth operation), the indicated need is for:

—12 to 14 megaship berths in the Atlantic: 7 to 8 in the North Atlantic and 5 to 6 in the South Atlantic.

—up to 23 megaship berths in the Pacific: 7 in the North Pacific and 16 in the South Pacific.

—up to 14 megaship berths in the Gulf.

These are very crude calculations fraught with assumptions, and it do not address terminal competitiveness issues or shipper/carrier requirements, but they do suggest that there may be a substantial unmet demand for large vessel berths at U.S. ports.

Putting aside these calculations, the ultimate test of "need" for megaship berths is whether carriers can deploy them profitably. Where this market need develops, terminal infrastructure to capture it usually follows. To date, carriers have deployed megaships almost exclusively on the U.S. West Coast. However, carriers are increasingly concerned that megaship capabilities be developed on the East Coast.

Atlantic Coast Ports

There are currently no 50-foot berths at Atlantic Coast ports, and there are no plans in place to provide any. Halifax and Hampton Roads have some berths at 45 feet, and the Port of New York and New Jersey plans to go to 45 feet at Port Newark/Elizabeth.

Pacific Coast Ports

Looking at the North Pacific ports, there are five berths that provide 50 foot water depths—three in Vancouver, BC (Vanterm), one in Tacoma (Terminal 7), and one in Seattle (Terminal 46). There will be two new 50-foot berths at Vancouver, BC (at Deltaport). Seattle, Tacoma and Portland are planning terminal improvements, but none provide 50 foot berth depths. Along with the five existing 50-foot berths, this brings the North Pacific total to seven.

In the South Pacific, there are three 50-foot berths at the Long Beach Container Terminal in Long Beach. Long Beach plans to add five new 50-foot berths at Long Beach (Hanjin and the Navy Complex), while Los Angeles will have access to eight such berths (APL and Pier 400) when their main channel is deepened. Along with the three existing 50-foot berths, this will bring the South Pacific total to sixteen.

Gulf Coast Ports

There are currently no 50-foot berths at U.S. Gulf Coast ports, and there are no plans to provide any. The maximum depth is at Houston, which is dredging its Deep Ship Channel to 45 feet.

IMPLICATIONS FOR FUTURE IMPROVEMENTS

The megaship requires adjustments to current terminal designs, but not radical restructuring. Planners should consider the possibility that vessel designs may evolve to the point where terminal designs must be completely overhauled. Just as the Panamax and Post-Panamax ships made finger piers obsolete, is there a vessel design that makes today's rectangular box container terminal irrelevant?

R. G. McLellan of P+O Containers looked at this question in the context of his 15,000 "flight of fancy" containership. He concluded that such a ship would need: (1) a huge 28-wide outreach crane, or (2) to be worked on one side, then pulled out and turned around and worked from the other side, or (3) worked simultaneously from both sides while sandwiched between finger piers, forcing designers to resurrect "old fashioned" layouts abandoned as unsuitable for containerships.

The Fast Ship Terminal is a good case in point for how a radical vessel loading strategy (airlifted container trains) results in a radical terminal design. Many in the industry feel that one or more of these radical technologies—the 15,000 TEU ship, Fast Ship, the TechnoSuperLiner or something else—has a good chance of penetrating the market in the next 15 years.

PROJECTED IMPACTS ON OPERATIONS

This background section provides an overview of operational impacts associated with the deployment of megaships. There are two broad categories of impacts: system-wide operational changes in vessel logistics and deployment, to which U.S. ports must respond; and in-terminal operating strategies that U.S. ports may need to pursue to maximize productivity while minimizing capital and operational costs.

VESSEL LOGISTICS, HUB PORTS, AND VESSEL DEPLOYMENT STRATEGIES

A number of factors enter into a shipper's or carrier's decision to deploy a given vessel on a given itinerary. These include, but are not limited to: port capability and facilities, cost for utilization of port facilities, transit and turnaround time, market size at port, ability to fill the ship on backhaul, adequacy of landside connections and customer preferences. Shippers and carriers regularly adjust their services in an effort to minimize costs and maximize service and revenue.

With the high capital cost of megaships, there is a huge cost associated with transit time. It is likely that calling at multiple ports will have a higher cost (in time) than the cost (in dollars) of serving these markets with feeder ships or landside modes (truck or rail). Choice of services is also being driven by port capabilities (who can handle these vessels?), comparative facility costs (ports negotiate leases on a competitive basis), availability of landside connections, and location of major customers.

An increasingly important factor is the trend to consolidate services and assets by shippers and carriers. In the past several years, as vessel and terminal development costs have increased, there has been tremendous growth in the number of shippers and carriers joining together in consortia to share assets, maximizing
utilization and minimizing redundant investments. Together, these factors make it likely that shippers and carriers will minimize their megaship ports of call and concentrate their operations in hub ports. Services between hub ports and other ports and market areas could be provided using feeder vessels and transshipment (a "hub and spoke" system) and/or intermodal rail.

Even if hub ports gain market share relative to the non-hub ports as shippers and carriers consolidate their services, it should be emphasized once more that the non-hub ports are not "losers"—even losing market share, they are likely to grow their Panamax and Post-Panamax services, as well as gaining traffic from feeder vessel services associated with hub ports.

Atlantic Coast Ports

Atlantic port services are extremely diverse and cover the globe. Just how many "hubs" will be needed in the Atlantic, and where they will be located, will be a function of available terminal infrastructure and carrier economics. The degree and location of hubbing on the Atlantic Coast is impossible to predict at this point, but several scenarios seem plausible:

—Maximum hubbing: megaships would handle the full potential market in DRI's forecasts. Deep draft hub ports would grow substantially faster than non-hubs, with impacts on non-hub ports' market shares. Under this scenario, there could be: a) northern and southern hubs, or b) northern, central and southern hubs, or c) multiple smaller hubs (some possibly with less than 50 feet of water) in each region. Potential candidates based on water depth, current traffic and location include—but are not limited to—Halifax, New York, Hampton Roads, Charleston, Savannah, Jacksonville, Everglades/Miami, San Juan and Freeport.

—Moderate hubbing: megaships would handle substantial cargo volumes, but less than the full share of the potential market in DRI's forecasts. Deep draft hub ports would grow faster than non-hubs, but with less significant impacts on non-hub ports' market shares than in the maximum hubbing scenario. Again, there might be either a few major hubs or multiple smaller hubs. Arguments in favor of this scenario are: (a) the optimal deployment of megaships is on a limited number of high-traffic corridors, and (b) Atlantic services are generally characterized by a mix of high-traffic corridors and diverse lower-traffic services with multiple itineraries and origins/destinations. The degree to which these lower-traffic services can be profitably consolidated will in large part determine the extent of hubbing.

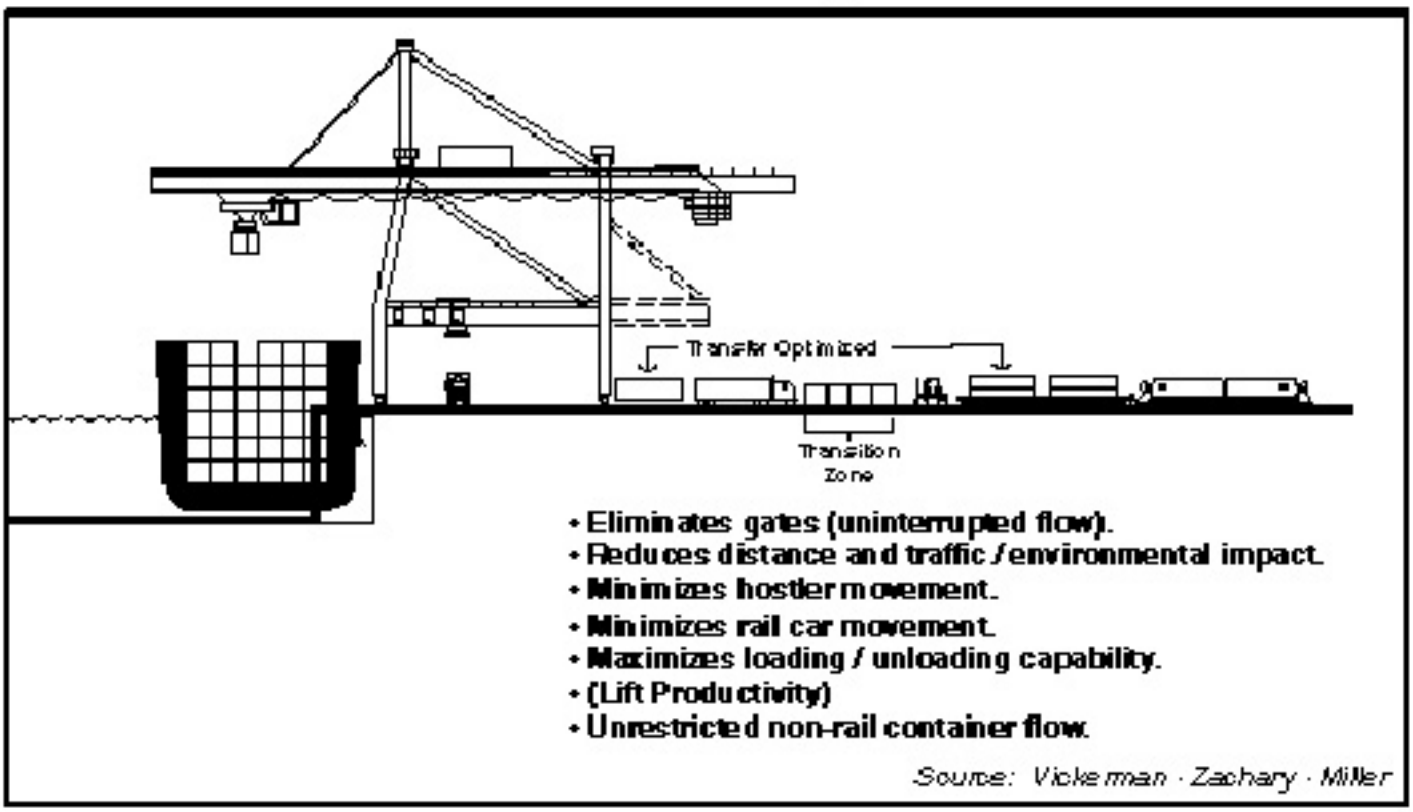
—Minimum hubbing: relatively few megaships would be deployed in the Atlantic due to port infrastructure constraints and carrier economics. These ships would be accommodated at deep-draft harbors which would grow at a faster than average rate, but other ports would not lose substantial market share since the great majority of cargo would be on vessels currently handled at these ports. This is considered the least likely scenario.

Pacific Coast Ports

"Containerisation International" identifies more than 150 principal trade routes for Pacific Coast ports. Typical itineraries for Far East-West Coast services fall into the following categories: (1) a single call at Seattle/Tacoma; (2) a call at Seattle/Tacoma with a second call at either Vancouver or Portland; (3) a single call at Los Angeles/Long Beach only; (4) a call at Los Angeles/Long Beach with a second call at Oakland; and (5) calls at both northern (Vancouver, Seattle/Tacoma, Portland) and southern (Los Angeles/Long Beach, Oakland) ports.

Megaships may be deployed on services that: (1) call at Seattle/Tacoma, with an optional second call at Vancouver, BC or Portland, and (2) call at Los Angeles/Long Beach, with an optional second call at Oakland. In this scenario, Los Angeles/Long Beach

Intermodal Interface—The Way it Could Be



Source: Vickerman · Zachary · Miller

and Seattle/Tacoma serve as major hubs, with other ports as subsidiaries. An alternative scenario is: (3) an additional service calling at Vancouver, BC with an optional second call at Seattle/Tacoma or Portland. This scenario, with Vancouver, BC developing as a significant hub, is quite possible based on its current and planned waterside and landside assets. Another alternative scenario is: (4) an additional service calling at Oakland, with an optional call at Los Angeles/Long Beach. The development of Oakland as a significant hub port is also possible, but will require significant new investments in waterside and landside improvements.

These scenarios illustrate the possibility of between two and four major West Coast hub ports. Services between hub ports and other ports and market areas could be provided using feeder vessels and transshipment (a "hub and spoke" system) and/or intermodal rail.

Gulf Coast Ports

Origin and destination ports for Gulf Coast services involve multiple ports of call in the Gulf, and the transatlantic services typically include one or more calls at major Atlantic Coast ports as well. It is possible to envision megaship services to Europe and the Mediterranean with one call at a Gulf port and one call at a South Atlantic port. If the infrastructure is available, it is also possible to envision services to Mexico, Central America and/or South America with one call at a Gulf port and one call at a South Atlantic port, or to Africa on a similar service. Megaships might also call at two separate Gulf ports on these itineraries. More than two calls in the Gulf on the same voyage seems less likely, since megaships need to be operated with a minimum of in-port time.

IMPACT OF TRANSSHIPMENT ON PORT INFRASTRUCTURE

The degree of transshipment that each carrier chooses to employ will have a dramatic—and potentially huge—effect on the need for port infrastructure. Let's assume that 500,000 TEUs per year are moved by a given carrier from Europe to the Atlantic Coast, with 250,000 TEUs to Port A and 250,000 TEUs to Port B. If none of this cargo is transshipped, then Port A and Port B each need to accommodate 250,000 TEUs over the wharf, in storage, through the gate, and into the landside access system. Port infrastructure capable of handling 500,000 TEUs per year would be needed.

However, if the carrier adopts a strategy of consolidating its cargo onto large vessels calling at Port A, with transshipment using smaller vessels to Port B, then the demand on port infrastructure is as follows:

a) Port A handles 250,000 TEUs of destination cargo, plus 250,000 TEUs of inbound transshipment cargo, plus 250,000 TEUs of outbound transshipment cargo. Port A needs to triple its wharf and crane capacity and double its storage capacity, even through no additional cargo is moving through the gate and into the region. This would have to be accomplished by: (a) expanding existing terminals; (b) developing specialized transshipment terminals; and/or (c) using midstream ship-to-ship transfer.

b) Port B handles 250,000 TEUs of destination cargo, with no change in its throughput requirements.

Port infrastructure capable of handling 1,000,000 TEUs per year would be needed to get 500,000 TEUs of cargo to Ports A and B.

Another transshipment option is to have all 500,000 TEUs go initially to interim Port C for transshipment onto vessels bound for Port A and for Port B:

a) Port A and Port B each need to accommodate 250,000 TEUs over the wharf, in storage, through the gate, and into the landside access system.

b) Port C handles 500,000 TEUs of inbound transshipment cargo, plus 500,000 TEUs of outbound transshipment cargo.

Port infrastructure capable of handling 1,500,000 TEUs per year would be needed to get 500,000 TEUs of cargo to Ports A and B. The key point is that aggressive transshipment practices could dramatically increase demands on port infrastructure, without additional traffic at origins and destinations.

ADVANCED TECHNOLOGIES AND LABOR PRACTICES

The development of hub ports will place maximum pressure on facilities to operate at maximum efficiency. Improving the throughput per acre of U.S. terminals will allow them to handle a maximum amount of cargo with a minimum of investment. Yet on a per acre basis, terminal productivity in the U.S. lags the rest of the world. United States ports handle an average of 2,144 TEUs per acre per year, versus 8,834 per acre for Asian ports and 2,974 TEUs per year for European ports. United States ports on the West Coast do substantially better (3,567 TEUs/acre) than East Coast ports (1,281 TEUs/acre).

The best Asian ports achieve their high throughputs through a combination of factors: (1) high rates of transshipment; (2) widespread use of advanced terminal equipment; (3) very intensive storage and berth utilization; and (4) around-the-clock operations. In most respects, this makes them noncomparable with U.S. ports. If Asian ports are excluded, the best non-Asian ports are handling an average of 4,000 TEUs per acre. Rotterdam, for example, achieves 4,400 TEUs per acre. Several U.S. West Coast ports are already close to achieving this number. The question is: how can the current level of performance be raised to meet or exceed this standard?

One strategy is the use of intermodal rail. The average dwell time for an intermodal container is about two days; for a non- intermodal container, it is anywhere from six to 28 days, depending on the port. For every container that is handled intermodally, you effectively triple (at a minimum) the storage capacity of the terminal.

Another strategy is intensive stacking. Chassis storage is extremely convenient in that it allows direct pick up and delivery by truckers without manipulating the container. However, you can get four times as much storage per acre by stacking four high. The trade-off, of course, is higher capital costs (rolling tire gantry cranes, straddle carriers, "top picks," etc.) and operating costs (labor to track and handle the containers).

Terminal operating costs can be reduced by using advanced terminal equipment. For example, Sea Land is using automatic driverless "bomb carts" to handle containers in the yard. Rotterdam also uses "elephant trains" (strings of chassis pulled by a single power unit) within their terminals.

Terminal operating costs can also be reduced by using advanced information technologies (a subset of Intelligent Transportation Systems, or ITS). Many terminals have developed "paperless" systems to process gate documentation. Beyond that, other systems are generally in beginning stages of deployment. Global Positioning System tags and visual readers are being used to identify and track yard equipment and containers in storage. Other systems have been developed to automatically weigh vehicles in motion, inspect containers for damage, and automatically optimize the storage and retrieval of containers using real-time computer simulation modeling.

Customs inspection is a key issue. With larger vessels offloading at ports in as little time as possible (in the case of a 5,000 TEU vessel, perhaps 4,250 TEUs in a 32-hour period), the demand on Customs agents will be sharply increased. The application of new information technologies may be part of the necessary response.

Ultimately, the cooperative partnership between labor and management may be the most important factor in maintaining and improving the productivity of U.S. ports. It may not be possible or desirable to

duplicate the management and labor practices of Asian ports, but there are lessons to be learned. One lesson is that a terminal operating 24 hours a day can handle substantially more cargo than a terminal operating 8 hours a day with a comparable level of capital investment. To date, the operating costs of such a strategy have been prohibitively high, although many ports work extended hours (and all work round-the-clock with a container ship at berth). But as ships get larger and the costs and impacts of capital improvements to serve them become increasing high, this approach may become more feasible.